



# SURGERY

## Gynecology and Obstetrics

An International Journal of Surgery

FRANKLIN H. MARTIN, M.D.

*Founder and Managing Editor, 1905-1935*

Volume 64

JANUARY TO JUNE, 1937

PUBLISHED BY

THE SURGICAL PUBLISHING COMPANY OF CHICAGO

54 EAST ERIE STREET, CHICAGO, ILLINOIS, U. S. A.



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116

# CONTRIBUTORS TO VOLUME 64

JANN, W	826	DAVID, VERNON C	281	HORSLEY, J SHILTON	313
FRANK E	504	DAVIS, DAVID M	330	HOUSEHOLDER, RAYMOND	373
STONEY	747	DAVIS, WARREN B	371, 537	HUTTON, JOHN H	888
REDGE, RUFUS HENRY	94	DAVIS, WILLIAM THORNWALL	546		
EN, ARTHUR W	838	DAVISON, MARSHALL	909	IRVING, FREDERICK C	178
NDOLA, FREDERICK H	76	DELONG, PERCE	516	IVY, ROBERT H	370
ERSON, ROGER	919	DEPREE, JAMES F	373		
SPACH, BROOKE M	337	DOHERTY, JOHN L	69	JACKSON, CHEVALIER	530
ARIES, LEON J	999	DOHERTY, JOSEPH A	69	JACKSON, HENRY, JR	465
		DOUBILET, HENRY	612	JACOB, HARRY G	995
		DRIPS, DELLA G	833	JAEALE, RUSSELL F	663
BABBITT, JAMES A	545	DUPERTUIS, S M	149	JENKINS, HILGER PERRY	648
BABCOCK, W WAYNE	311			JOHNSON, BALBINA	387
BACKER GRONDAHL, N	1073	ELGART, J	673	JUDIN, S S	63
BALFOUR DONALD C	565	ELIASON, ELDRIDGE L	301, 1005		
BALLON DAVID H	226	ERB, WILLIAM H	1005	KANAVEL, ALLEN B	118
BALLON HARRY C	226	ESSER J F S	102	KEENL, FLOYD C	336
BARGEN, J ARNOLD	849	EVERSOLE, URBAN H	156	KIRSHBAUM, JACK D	944
BARTLETT, WILLARD	249			KOCH, SUMNER L	1
BECK, CLAUDE S	270	FAHEY, JOHN J	876	KRETSCHMER, HERMAN L	634
BENEDICT, WILLIAM L	513	FALLS, FREDERICK H	895	KRUMBHAR, EDWARD B	303
BERENS, CONRAD	538	FANTUS, BERNARD	895	KUDER, ALBERTA	51
BERKHEISER, E J	1064	FERCLOT, C F	831		
BESLEY, FREDERIC A	372	FEWELL, A G	550	LAHEY, FRANK H	79, 304
BLAIR, VILRAY P	358	FONTAINE, RENÉ	149	LAMBERT, JOHN H	508
BLALOCK, ALFRED	245			LANE, LAURA A	458
BLAND, P BROOKE	344	GEMMILL, W F	738	LAZENBY A D	393
BROWN, HENRY P, JR	561	GHORMLEY, RALPH K	950, 1094	LEE, WALTER ESTELL	322
BROWN, JAMES BARRETT	358	GILBERT, PHILIP D	1005	LEICHEL, RENÉ	149
BUMPUS, H C, JR	324	GILE, HAROLD H	1046	LEWIS, RAYMOND W	1079
BYARS, LOUIS T	358	GRAHAM, A STEPHENS	59	LEWISOHN, RICHARD	172
		GRAHAM, ALLEN	609	LICHTENSTEIN, MANUEL E	684
CALLAHAN, JAMES J	218	GRAHAM, ROSCOE R	235	LITUM, ROLF	79
CAMPBELL, MEREDITH F	22	GREENOUGH, ROBERT B	497	LOOPER, EDWARD A	524
CARMODY, T E	517	GURD, FRASER B	1085	LUEDDE, W H	552
CARROLL, HOWARD B	121	GUSTAFSON, GERALD W	1035	LYNCH, FRANK W	338
CHAFFIN, LAWRENCE	811	HARMON, PAUL H	876		
CHRISTOPHER, FREDERICK	711	HARRIS, R I	1092	MACEachern, MALCOLM T	562
CLARA, ALBERT G	663	HART, VERNON L	794	MACLENNAN, ALEXANDER	447
CLOCK, RALPH OAKLEY	1027	HAWLEY, GEORGE W	1074	MARSHALL, SAMUEL F	1055
CODMAN, E A	485	HELLER, RICHARD E	971	MASON, MICHAEL L	129
COGSWELL, H D	793	HELLWIG, C ALEXANDER	604	MASON, VERN E	811
COLP, RALPH	622	HENDERSON, MELVIN S	454	MASSON, JAMES C	617
CONNELL, F GREGORY	836	HENRY, CHARLES K P	499	MATHIEU, ALBERT	1021
CONWELL, H EARLE	94	HERTIG, ARTHUR T	39, 178	MCCARROLL, H R	721
CRAIG, WINCHELL MCK	950	HICKEN, N FREDERICK	593	MCGUIRE, WILLIAM P	841
CRILE, GEORGE	927	HINMAN, FRANK	785	MCDONOE ARCHIBALD II	376
CRILE, GEORGE, JR	927	HINTON J WILLIAM	16	McLANE, CHARLES M	51
CUBBINS WILLIAM R	218	HOAG, CARL L	1051	MELENEZ, FRANK L	387
CULVER, HARRY	944	HOFF, H E	165	MENTZER, STANLEY H	712
CUTLER, E C	892	HOLDER, HALL G	239	METZ, ARTHUR R	373
CUTLER, J W	820	HOPE, ROBERT B	229	MEYER, HERBERT WILLY	675

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Original appearing in M. 101

# SURGERY

## GYNECOLOGY AND OBSTETRICS

*An International Magazine, Published Monthly*

VOLUME 64

JANUARY, 1937

NUMBER I

### OSTEOMYELITIS OF THE BONES OF THE HAND<sup>1</sup>

SUMNER L. KOCH, M.D., F.A.C.S., Chicago, Illinois

**I**N D McCrae Aitken's little volume entitled *Hugh Owen Thomas, His Principles and Practice* are some notes from Thomas' Case Book recording details of cases of particular interest. The first case is as follows:

"Case No. 1. Capt J. William J. Jensen, May 11th, came under treatment. Caries of metacarpal bone of Index Finger.

"When I first saw him he was pale in appearance, night sweats, the wound appeared bloody, but the granulations were pale and the edges of the wound flabby. The history he gave of his own case was that he pricked his finger, which, from neglect, became inflamed, suppurated, etc. His medical attendant removed the 3rd and 2nd phalanges. Afterwards the 1st became carious and it, with the head of the metacarpal bone, was removed. Again the metacarpal bone became carious, and his medical attendant advised its removal, before doing so, my patient, the Captain, consulted the Staff of the Royal Infirmary, Liverpool, and they advised the removal of the index metacarpal of the right hand.

"At this stage he consulted us, E and H (Evan, the father, and Hugh, the son), and we gave it as our opinion that the above operation was not needed."

Aitken continues

The reasons are annexed. The bone could not be removed without cutting into the wrist, and last, the former operations had failed, how could he tell that this would not also fail? On May 11th the patient came under Hugh Owen Thomas, who dressed

the wound, but strapped the wrist and hand firmly. On June 15th all was healed, and then there is a final note: "Well at Rio Janeiro, November 20/57."

It is consistent with his attitude toward the many medical problems which he solved successfully that the first authentic record we have of Hugh Owen Thomas' work should involve the conservative treatment of osteomyelitis of the bones of the hand.

The importance of such treatment in the presence of osteomyelitis which is secondary to infection of the overlying soft tissues or which results from infection of open wounds—which Thomas recognized so early in his career—deserves further emphasis. It is a principle often ignored and often forgotten. It is of especial importance in connection with osteomyelitis of the bones of the hand, for nowhere is the bony framework of more importance for normal function. Nowhere is osteomyelitis secondary to infection of the overlying soft parts more common.

The latter consideration is of significance. Osteomyelitis of the bones of the hand and wrist, except when secondary to tuberculous or syphilitic infection, is invariably due to infection by continuity with the covering tissues or the result of compound injuries with primary or secondary infection of bone. The destruction of bone that takes place might be compared with the erosive action of a turbulent stream of water upon a wall of rock.

<sup>1</sup> From the Department of Surgery, Northwestern University Medical School. Read before the Chicago Surgical Society April 3, 1936, and the Nebraska State Medical Society, Lincoln, Nebraska, April 7, 1936.

(Fig 1) Only three things are essential for its successful treatment adequate drainage of the soft parts, care to avoid adding secondary infection to that which is already present, and care to avoid adding injury to that which has already occurred<sup>1</sup>

Not only is it often forgotten that such treatment is adequate, but a second fact is frequently ignored—that unless actual sequestration has taken place one cannot determine by inspection even in a bloodless field where necrosis of bone ends, where the protective wall of inflammatory reaction begins and ends and where normal bone begins. For some inexplicable reason that primary law of surgery *nihil nocere* is often forgotten by the surgeon when he reads the radiologist's report Perio-titis or beginning osteomyelitis etc

The surgeon who is confronted with an infected wound of the soft parts reasons correctly that he must not destroy viable tissue nor risk carrying infection more deeply and disseminating it more widely. Yet when confronted with a beginning infection of the cov-

ering or superficial tissue of the bone he often cuts ruthlessly with curette or chisel, and carries out a procedure which he would unreservedly condemn if the pathological process involved only the more superficial tissues. It is our belief that an infection of periosteum or underlying bone which is secondary to involvement of overlying soft tissues is pathologically identical with an infection of skin and subcutaneous tissues (Fig 1), and that the same principles of treatment should be applied adequate drainage with a minimum of operative trauma, and aseptic care of the wound so as not to add secondary infection to that which is present. Adequate drainage moreover with infection of the anterior closed space of the distal phalanx does not necessitate the use of a fish mouth incision around the end of the finger such as has been described in many textbooks of surgery and lately suggested again by Cotton and Morrison. We have never failed to secure adequate drainage through an incision made on one side of the finger alone but we have been careful through this incision under the vision possible with a bloodless field to cut across the fibrous septa that run vertically from the skin to the periosteum of the distal phalanx and so to make certain that no unopened pocket of pus was left undrained (Fig 2). On a

The same principles apply with equal force to osteomyelitis secondary to infection of the overlying soft parts in any part of the body. How directly the statements made apply to the treatment of osteomyelitis of the jaw is very effectively pointed out by Blair and Brown in their excellent paper on osteomyelitis of the bones of the skull and face.

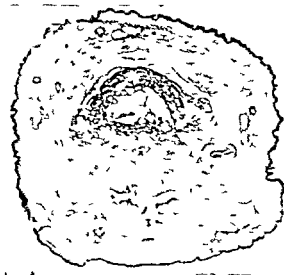


FIG 1 Cross-section of middle phalanx of a finger amputated because of suppurative tenosynovitis and destruction of flexor tendons. There is destruction also of periosteum and the superficial layer of bone on volar surface of phalanx (V) as a result of spread of infection from overlying soft tissues.

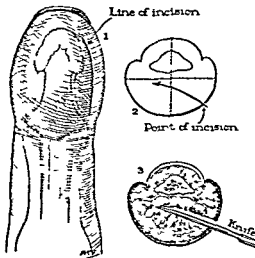


FIG 2 Incision for drainage of infection of anterior closed space of distal phalanx ( felon ) ( J Am M Ass, 1929 Q2 1173 )



Fig 3 Case 1 a, b, X ray films showing appearance of distal phalanx of left thumb 23 days after the onset of infection of the overlying soft tissues c, d, Appearance of bone 6 years after operation

number of occasions, moreover, we have had to excise the depressed gutter-like scar left after a fish mouth incision so as to secure a smooth and normally functioning finger tip.

If in the course of an infectious process involving the hand necrosis of any part of periosteum or bone takes place, the necrotic tissue will be extruded, just as necrotic skin or subcutaneous tissue slough away, or it can be lifted out of the open wound with very little difficulty (Fig 3). If one attempts, however, to determine the line of demarcation with chisel or bone biting forceps he invariably adds injury, destroys bone which might be saved, and delays the process of healing. These considerations hold true whether the area of bone infection involves the diaphysis, the epiphysis, or the articular surface. We have frequently seen resolution and healing follow conservative treatment in cases in which the infection involved the articular surfaces of both bones forming a metacarpophalangeal or an interphalangeal joint.

The following case reports indicate what can be accomplished in infections of the hand accompanied by osteomyelitis.

**CASE 1** P M H, 2591, May 3-6, 1930. This patient, a dentist of 38 years, was first seen May 3, 1930. 23 days after the abrupt onset of pain in the distal phalanx of the left thumb. During this 23 day period the thumb was incised and drained on 5 different occasions. On admission there was a draining sinus on the volar surface of the dorsal phalanx

with some thick purulent discharge. The thumb was still swollen and exquisitely painful.

Under gas anesthesia the incision present was extended proximalward, the fascial septa on either side divided, and an irregular splinter of bone,  $\frac{1}{2}$  inch long, lifted out of the wound. A thin shell of bone, the cortical layer lying just volar to the nail bed, was left untouched. Warm wet dressings were applied continuously for 3 days. The patient left the hospital May 6. The operative wound was healed May 16, 10 days later. Figures 3 and 4 show the x ray findings at the time of operation, again in March, 1936, and the appearance of the thumb on the latter date.

**CASE 2** P M H, 16907, February 10-23, 1934. This patient, a physician of 26 years, injured his left index finger during a tonsil operation February 3, 1934. Two days later the finger became swollen and painful. February 6 a small incision was made in the finger but no pus was obtained. February 8 it was again incised.

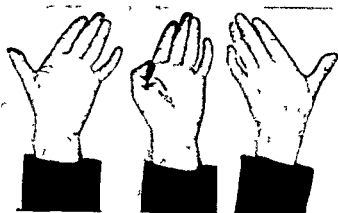


Fig 4 Case 1 Appearance and function of thumb 6 years after operation



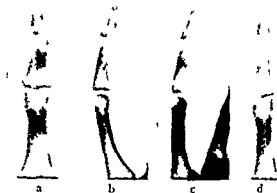


Fig. 5. Case 2. X-ray films showing progressive osteomyelitis of distal phalanx of index finger, with eventual sequestrum formation followed by healing and with preservation of proximal end of bone and the attached flexor and extensor tendons. a b February 26, 1934, 23 days after injury of finger tip. c d March 6, 1934. (Continued on next page.)

1935. The wound was sutured by the physician who first saw him and extension was applied to the thumb.

Six days later he was admitted to the Cook County Hospital with an acute spreading infection of the hand and forearm and extensive necrosis of the palmar skin along the line of the sutured wound. Because of the spreading infection the banjo splint of plaster and wire which had been applied was removed and the hand left unsplinted for 10 days. During this period rotation of the distal fragment through an arc of 90 degrees took place and the subsequent attempt to correct its position by splinting was unsuccessful. I saw him shortly before Christmas with an accumulation of pus under the deep fascia of the thenar eminence. This was incised to give better drainage and every effort was made to combat the infection and secure healing. The patient remained in the hospital until January 4, 1936, and returned for dressings three times weekly during January and February. Healing was complete at the end of February; the fractured bone was firmly united and the thumb saved.

CASE 6. P. M. H. 23770. September 20-October 6, 1935. This patient, a window washer of 27 years, sustained a lacerated wound over the dorsum of the metacarpophalangeal joint of the right thumb with division of the long extensor tendon. August 30, 1935. The wound was immediately repaired but apparently with little care to ensure its cleanliness. Four days later he was admitted to the Cook County Hospital with an acute spreading infection and a week later was transferred to the Lutheran Memorial Hospital under the care of the city physician.

When he was first seen September 23, he was pale and anemic and showed the obvious effects of continued infection. The entire thenar area of the right

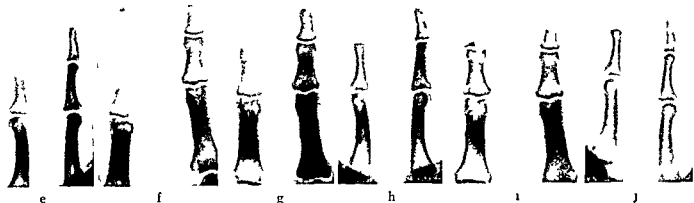


Fig 5 (continued) e, f, March 27, 1934, just after removal of sequestered diaphysis g, h, April 21, 1934, 18 days after healing of soft tissues was complete i, j, March 25, 1936 In the last 6 illustrations the right index finger is included for comparison

hand was swollen and inflamed (Fig 10) He was greatly disturbed at the decision that had been made by his surgeon that amputation of the thumb offered the only hope of recovery

On September 29 the patient was admitted to Passavant Memorial Hospital, and large wet sterile dressings were applied to the hand and forearm October 1 the thenar area was incised to permit drainage of a subcutaneous abscess which had formed under the thenar skin and extended under neath the web to the dorsum of the hand Cultures of the wound secretion showed both a hemolytic *Staphylococcus albus* and a hemolytic streptococcus Convalescence and recovery were slow, but healing was finally complete January 1, 1936 Although ankylosis at the metacarpophalangeal joint resulted from the destruction of the adjacent articular surfaces (Fig 9, c, d) the thumb was saved, the patient was able to return to his former occupation January 15, and with little loss of function of the affected hand (Fig 10, c, d, e)

If it should be argued that conservative treatment is often time consuming and that many patients cannot afford to await the results of such treatment, it is well to remember that radical treatment can prove disastrous as far as both function and loss of time are concerned The following case is a striking illustration of these facts

A skilled artisan of 49 years sustained a needle wound of the distal phalanx of the left thumb March 28, 1934 By April 7 the thumb had become painful and inflamed It was incised under gas anesthesia April 10 April 14 the incision was extended and the bone curetted April 20 the entire distal phalanx was removed through a dorsal approach and the wound left widely open The appearance of the bone as shown in x ray films on April 20 and on April 26 is shown in Figure 11 Various types of dressings including packs moistened with hot salt solution, mer-

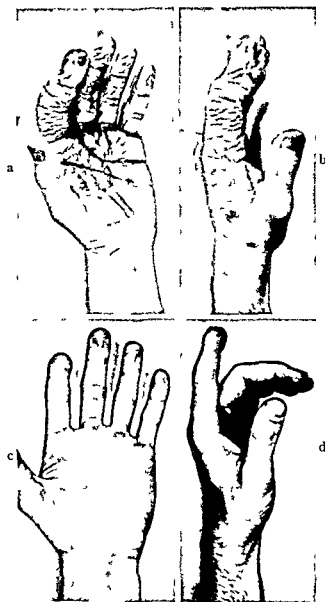


Fig 6 Case 2 a, b, Appearance of finger just after incision of distal phalanx, February 10, 1934, and, c, d, 18 months later



Fig. 7 Case 4. X-ray films showing a destruction of articular surfaces of proximal interphalangeal joint of index finger and b c result 3 months after the injury. 3 months after healing of the soft tissues was complete

curochrome dressings flatseed poultices magnesium sulphate packs dressings saturated with bacteriophage irrigations with Dakin's solution and boric acid solution and icebags had been used throughout this period. The highest temperature recorded was 99.8 degrees. Bacteriologic cultures made on 2 occasions showed only a *Staphylococcus aureus*.

The patient was first seen by us May 11 with the infected granulating wound left after the removal of the distal phalanx. A rigid flap consisting of the palmar skin of the distal phalanx was present and in the base of the open wound was the exposed head of the proximal phalanx.

The thumb was treated only with continuous warm wet sterile dressings until the granulation tissue became red and healthy and subsequently with dressings saturated with Dakin's solution. As the granulation tissue improved in appearance the palmar flap was pressed dorsalward over the exposed proximal phalanx so that it would adhere to it and cover it. In spite of the fact that the sheath of the flexor pollicis longus had been opened with the amputation of the distal phalanx and that the articular surface of the proximal phalanx had been continually exposed to the infectious process healing gradually took place.

He was dismissed from the hospital June 1, 1934 with the thumb almost healed only to return 2 weeks later with some recurrence of inflammation in the thumb and a thrombophlebitis of the veins of the volar surface of the forearm. This gradually subsided under conservative treatment and he was

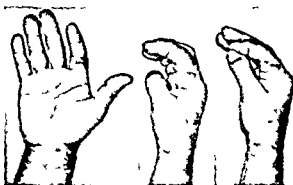


Fig. 8 Case 4. Appearance of injured finger and extent of function present 3 months after injury

dismissed the second time July 1 with little evidence of residual inflammation. July 26 he was readmitted to the hospital for the third time because of the persistence of a discharging sinus which led to a cavity underneath the palmar flap which had been turned dorsalward over the head of the proximal phalanx. The sinus was gently curetted and some small bits of dead bone and bone sand removed. The patient reported that healing was finally complete 2 weeks later. Almost 5 months after the original injury had been sustained.

Case reports might be multiplied indefinitely. Suffice it to say that for a number of years and with a considerable number of cases under our observation we have not once found it necessary to amputate a finger or a part of a finger because of osteomyelitis. The most striking group of cases we have observed has been that in which the infection followed a bite or a fist fight (4). In spite of the well known virulence of such infections and the fact that in such cases a mixed infection with many types of organisms is invariably present, these patients when treated conservatively have all recovered (Fig. 12). Not infrequently an ankylosis at the joint involved has followed intra-articular infection but in spite of that fact the bones have been saved.

In contrast with these results of conservative treatment is a case observed recently in which a simple infection of the soft parts of the index finger was allowed to progress to an osteomyelitis of all three phalanges by reason of constant addition of infection from during prolonged treatment of the infected

We have twice amputated fingers because of complete loss of function resulting from suppurative tenosynovitis, destruction of flexor tendon complicating osteomyelitis and resulting ankylosis but only after the finger was completely healed.



Fig 9 Case 6 a, b, X ray films showing involvement of bones forming metacarpophalangeal joint of thumb 4 weeks after patient had sustained a lacerated wound over the joint, followed by spreading infection of the soft tissues c, d X ray films showing appearance of bones 7 months after the injury and 3 months after healing of the soft tissues was complete

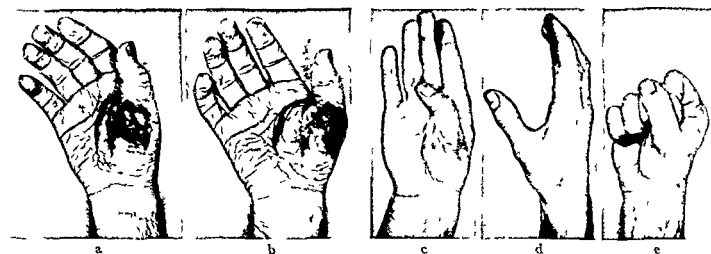


Fig 10 Case 6 a, b, Appearance of hand on admission to the hospital and, c, d, e, 6 months later, 3 months after healing was complete

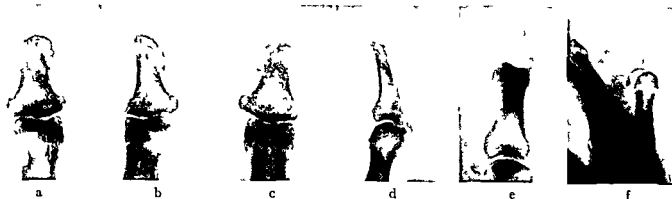


Fig 11 Complete amputation of distal phalanx for osteomyelitis so slight as to be scarcely recognizable in x ray films a, b April 20, 1934 c, d, April 26 e, f, May 9

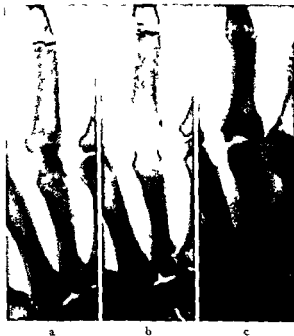


Fig. 12 Result of conservative treatment of osteomyelitis with involvement of articular surfaces of metacarpophalangeal joint of ring finger subsequent to human bite infection of hand (*Surg. Gynec. & Obst.*, 1930 51: 616) a, February 4, 1930; b, February 25, 1930; c, April 12, 1930.

hand with a poultice consisting of oatmeal and other ingredients.

A word should be added concerning the interpretation of x-ray films. The radiologist who focuses his attention solely on roentgenographic findings frequently forgets how quickly atrophy and absorption of calcium can occur in the bones of a hand which is kept immobilized even for a few weeks. Not uncommonly the loss of sharp outline associated with absorption of calcium is misinterpreted as an inflammatory process, or an

area in which a limited inflammatory process is present becomes an area of "extensive osteomyelitis and bone destruction" because the radiologist ignores the part which absorption of calcium has contributed to the appearance of the bone shadows. With the radiologist's diagnosis of extensive inflammation and destruction of bone, too often radical operative procedures are carried out with most unfortunate results as far as the framework and function of the hand are concerned.

#### SUMMARY

The essential factors in the treatment of osteomyelitis of the bones of the hand are adequate drainage of the overlying soft parts, cleanly surgical care, and avoidance of trauma—by irritating chemicals, by addition of infection from without, and, particularly, by the use of curette and chisel. If death of bone takes place a line of demarcation forms and the necrotic bone, if it is not extruded spontaneously, can be removed without trauma. To attempt to determine a line of demarcation by surgical intervention too frequently results in destruction of living bone and extension of infection, and often makes recovery of the affected bone impossible.

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## SMALL BONE REPAIR<sup>1</sup>

KELLOGG SPEED, M D, F A C S, Chicago, Illinois

THE small bones may include the phalanges, tarsals, metatarsals, carpals, and metacarpals. Injuries to and fractures of these bones are quite frequently belittled in clinical and medicolegal investigation. Although these different bones are not all of the same type, some being really long bones, they may be regarded as similar in so far as repair is concerned and they may be grouped together on account of their anatomical locations and their intimate relationship to the use of the hands and legs in industry or important acts of daily existence.

The phalanges and metacarpals or metatarsals have a distinct cortex, relatively thick in the middle of the diaphysis enclosing a medullary space which is irregularly quadrilateral in shape merging into finely meshed ends, the delicate trabeculae of which spread out to support the articular surfaces of the bone. The tarsals and carpals have no definite medullary space, their interior structure consisting of loosely meshed trabeculae and cancellous bone.

Fracture of these small bones must include any traumatic severance or disarrangement, not only of the cortical layers but also of the bony trabeculae which make up the internal structure. Such derangement in the bone may lead to clinical symptoms of tenderness, delayed functional return in the part, as well as long continued reconstructive efforts within the bone aiming to restore it to as near normal as possible and fundamentally characterized by changes in the blood supply. No intention is made to include inflammatory reaction arising from any infective process within the bones, but it is desired to deal solely with traumatic lesions.

From a study of changes in the bones of extremities amputated because of arteriovascular disease, Jaffe and Pomeranz found that it did not matter how long sustained or how advanced the organic vascular disease of an

extremity may be, no specific or characteristic changes in the bones are consistently demonstrable roentgenographically. This is because there is no periosteal reaction on account of the devitalization of the soft tissues about the bone and the fact that the bone itself is dead, retaining its original structure and density for a long period until quite largely substituted or absorbed, a process which cannot take place on account of the vascular change present in the patient suffering from these diseases. The roentgenological findings in traumatized live bones are on a different basis and require a different interpretation—when portions of a bone have become revived and absorbed or replaced, the roentgenological appearance is that of spotty rarefaction.

If one uses roentgenological study of bones for a clinical measure of their progress in healing, structure, and state of health, osteoporosis, in the roentgenogram, has come to mean a diminution in bone density and shadow caused by a melting away of the superficial portion of the trabeculae with a resulting thinness or complete disappearance. This porosis may be accompanied by a change in the calcium content of the bone, or with vascular disturbance within the bone not demonstrable by the roentgen film. It has been called osteitis or malacia, but after all, it is merely the roentgenological registry of progressing diminution of bone substance.

A lowering of the amount of calcium in a bone below its normal content may occur without any marked structural change. This is expressed by a lessened shadow on the film because of lack of shadow casting calcium salts. A microscopic section of such bony tissue shows ordinary bone structure, but with lessened calcium salt content and is to be found in varying amounts wherever atrophic changes in bone are going on. This demineralization of bone is also called halisteresis.

Repair of bone, after fracture, requires an ingrowth of blood vessels into pre-osseous or osteoid material and some writers have main-

<sup>1</sup>Read before the Chicago Surgical Society, Chicago, Illinois, April 3, 1936.

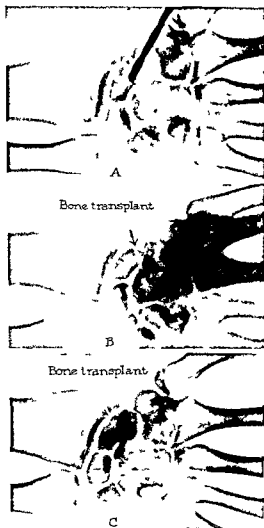
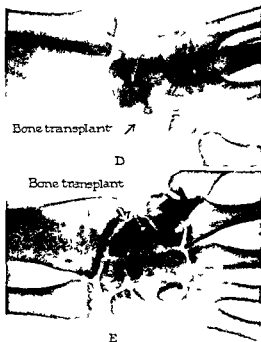


Fig 1 A Ancient fracture right navicular ununited. Operated upon July 31, 1934. A drill was inserted via the tabatiere but was misdirected at the first insertion as shown by a roentgenogram not reproduced here. The drill was withdrawn and reinserted correct direction was obtained and the drill was then driven well into the proximal fragment. In this channel it was planned to insert a bone transplant from the tibia. In placing the bone transplant



however it chose to follow the wrong drill path and did not go into the proximal fragment of the navicular but angled off toward the capitate bone. B Day after operation for drilling the navicular. The ununited fracture of this bone is seen indicated by the arrow with the slender transplant passing from the distal fragment toward the capitate but not penetrating the proximal fragment of the navicular. The hand is in a plaster splint. C Same wrist February 13, 1935 6½ months after operation. The navicular appears to be healing. The transplant is still unabsorbed but its greater comparative density seems to indicate its necrosis. D Oblique view of same wrist on April 19, 1935 nearly 10 months after operation. The navicular seems healed. On account of the axis of the roentgenogram it appears as if the bone transplant stretched diagonally across and within the navicular. E Anteroposterior view of wrist same date as in D showing healed navicular and misplaced partly absorbed bone transplant. Union here could hardly be attributed to the transplant which never crossed the fracture plane. Final solidification must have resulted from the irritation of drilling followed by prolonged immobilization.

tained that bone may thus be formed from the endothelium of the blood vessels, rather than from fibroblasts or osteoblasts. Mesenchyme tissue may develop into fibrous tissue, cartilage, or bone and the deposit of calcium salts, with the aid of phosphatase, is a reversible process both physically and chemically. Fractured small bones may show roentgenologically both osteoporosis and demineraliza-

tion and yet retain life and reviving powers when given a chance to come back.

It must be conceded that medullary bone possesses power of regeneration when disturbed or transplanted into expectant osseous surroundings. The experiments of McGaw and Hardin demonstrate the regenerative power of freshly transplanted bone marrow and endosteum where parts of the shaft of the

fibula, including periosteum, were completely resected and substituted for by medullary tissues. King has stated it thus "Bone arises, in some circumstances, directly from mesenchyme. In other cases it develops by way of an intermediary cartilage, and this may occur with or without gross resorption of cartilage, i.e., the cartilage may revert to indeterminate tissue and then give rise to bone or may be transformed directly to osseous tissue. In still other circumstances, tissue which normally becomes transformed directly to bone may form cartilage. The circumstances which determine the formation of a particular variety of tissue in a given area are but incompletely known. All the connective tissue cells in the region, however, possess the potentiality for the production of the tissue, whether it be cartilage or bone and the appropriate stimulus causes the formation of the corresponding tissue."

In spite of the belief of Leriche and Policard, C. R. Murray, and others, extracellular substances such as boiled bone grafts, lime salts, traumatized muscle, and fascia (supposedly a local source of calcium salts) when surgically implanted in a fracture site will not produce new bone or necessarily lead to bony union. There is yet no definite evidence in carpal and most other small bone fractures that change in the local acidity has much to do with final bony healing, although phosphatase is supposed to be activated by a favorable hydrogen-ion concentration leading to a deposit of phosphates. I had a patient who developed union in an ununited navicular after correct drilling but misplaced insertion of a bone transplant. Although it appeared roentgenologically dead and undergoing slow absorption, it seemed certain that the transplant was not a local source of calcium salts exactly in the fracture area. It did not cross the fracture plane. Change in local acidity after fracture, according to Stirling, lasts but a few days and is associated with the initial death of tissue at the fracture site. This local necrosis may act as a source of available calcium, but in most bones it seems to be an inadequate quantity for the complete process of healing. The theory of Leriche and Policard may explain union occurring in a small bone,



Fig 2 A, Ununited fracture of navicular of 1 year's duration on August 13, 1935. This was treated by simple immobilization of the hand, wrist, and forearm in plaster of Paris. B, Same wrist on December 19, 1935, showing healed navicular with reforming bone trabeculae apparently arising from osseous tissue about the fracture site.

like the navicular, by treatment with prolonged immobilization solely on the basis of vascular change after a pre-existing long period of non-union, when no operative procedure has been followed. If, following treatment with prolonged immobilization, final union takes place in a small bone, we may begin to believe that it is the result of osseous tissue cell activity revived in living cells when rested and possibly stimulated by changed blood supply. Small live grafts may lead to union, as shown by Stewart, Gordon Murray, and many others, but in the small bones it is doubtful whether they are an absolute necessity. Their use or the trauma of the tissues incidental to their application or insertion, especially if inside the cortical wall of bone, may expedite the final time of bone healing, but this is not positively proved. Cancellous bone, when given a chance, i.e., when restored to normal circulation and left undisturbed,



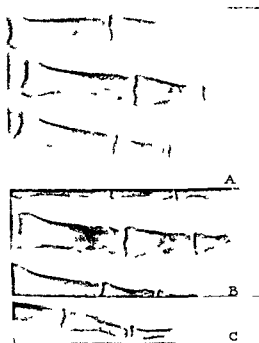


Fig. 3 A Chondroma of middle phalanx of middle finger in a young adult male dental student. The destruction of bone and its replacement by the benign cartilaginous growth is seen. No pathological fracture has yet occurred but the finger is painful after use and function is interfered with. November 4, 1931. B and C Anteroposterior and lateral views of same finger on December 29, 1931, 7 weeks after operation which consisted of lateral approach of the phalanx by cutting open its cortex and scooping out all the tumor tissue under direct vision. This space was allowed to fill with aseptic blood clot, the finger wound being tightly closed and splintage applied for 4 weeks. Note the formation of new bone and new trabeculae. There is no deformity of the phalanx and no excess osseous tissue has developed. This lesion went on to complete cure and the lesion lost all identity within 6 months.

will nearly always renew itself and go on to union.

Turning to the clinical purpose of this discussion, we find that Smith and Rider called attention to the slow character of final healing and bone restoration demonstrated by roentgenogram, after fracture of the phalanges. This point is again called to your attention and the fact that all small bones require a long ossifying interval must be acknowledged.

It is found that even simple chip fractures of the phalanges and metacarpals heal with extreme slowness with continued symptoms of local tenderness and pain on use of the finger or joint, when that is involved. Small bone fractures are often expected to heal rapidly

and enforced use of the part may increase the time and amount of disability. They require 12 to 20 weeks for full bony restoration certified by roentgenogram. Clinical healing may be satisfactory in half that time.

The carpal bones are the most difficult problem of all. In his excellent paper in 1927, Johnson again called attention to the length of time lesions of the navicular, as compared to the radius, required for repair. His experimental work confirmed previous clinical observations on fractures of this bone. He felt able to conclude that in the ordinary fractures of the navicular, the fragments are not to any extent deprived of properly nourishing blood supply because he found but the slightest amount of bone necrosis, such as might occur in any fracture or after trauma. He also noted that in the later stage of repair reaction there was much less hyperemia in the navicular than in the radius, that there was no periosteal callus and that the lesion in the covering cartilage healed by fibrous tissue. Hyperemia was found only in a narrow zone adjacent to fracture plane or drill hole, the main body of the navicular showing a very mild degree of increase in vascularity. Where this bone is covered by ligamentous attachment, the fibrous tissue reaction often amounted to an overgrowth. Bony repair reaction, mainly expressed by increased blood supply within the navicular, appears quite as early as in long bones but the reaction is quite local and not as active as in long bones. It is inhibited by use and movement resulting from improper immobilization. The medullary response in long bones is both more active and more productive and reaches a more advanced stage of development in a shorter time than in corresponding cancellous bone of the navicular. It must be admitted, therefore, that the ossifying interval of the navicular is slow and laborious. There is no histological difference in this process of ossification of the bone, however. It passes through stages of formation of blood clot invasion, and organization by newly formed thin walled blood vessels, development of fibrous tissue, in which osteoblastic elements appear, transition into osteoid tissue leading to truly formed trabecular osseous structure.

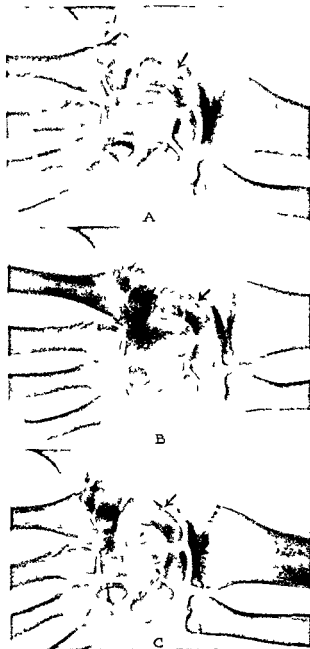


FIG. 4. A Ununited fracture of the navicular in an adolescent male 6 months duration, October 30, 1934. B Same wrist on January 14, 1935 after continuous splintage of hand, wrist and forearm. Not yet completely healed. No operation performed. C, Same wrist on June 3, 1935 about 10 months after treatment was first started. Bony union seems complete in the navicular, but without any excess bone or parosteal shadow.

Johnson was led to conclude that the natural close approximation of the fragments of the navicular, after its fracture, permitted no undue mobility. Non-union and delayed union of this bone, he felt, could not be attributed to the mobility existing after fracture. He stated that the limited zone of bony repair in the navicular suggested that the

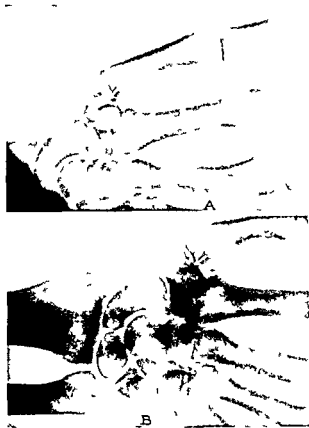


FIG. 5. A Ununited fracture of greater multangular bone of 5 months duration. There had been a coincident fracture of the first metacarpal bone, still incompletely healed with some deformity but with little excess callus. The patient was a professional boxer and could not carry on his work. Roentgenogram July 10, 1934. B, Same hand December 11, 1934. Complete rest in plaster of Paris cast had led to union after 5 months. Both metacarpal and multangular bone are now united and bony trabeculae have lined up normally.

skeletal function of the bone was perhaps of secondary importance to its hematopoietic function, differing from the reaction in the shafts of long bones where the reverse might be true and the skeletal repair be considered pre-eminent and consequently more active.

These conclusions, I believe, are erroneous because clinically there is motion between fractured navicular surfaces. Crepitus may be felt by both surgeon and patient. It does not seem possible in our physiology that the active wrist bones, subject to constant pressure in thousands of daily uses, built of daintily trabeculated cancellous bone, could possibly be of enough hematopoietic importance, compared to femur, tibia, vertebral bodies, and other bones, to warrant a natural tendency to non-union with sacrifice of their skeletal function of support just to supply a

# THE TRANSFORMATION OF GASTRIC ULCER INTO GASTRIC CARCINOMA<sup>1</sup>

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**I**N discussing the transformation of gastric ulcer into gastric carcinoma, the criteria by which such a diagnosis is arrived at are very difficult to evaluate. It is equally true whether we refer to histopathological studies, roentgenological findings or the fractional test meal. The clinician is concerned whether any method of diagnosing a gastric ulcer undergoing carcinomatous changes actually exists. Scott states "In spite of an intensive search for some method of demonstrating when an ulcer is malignant it is admitted almost universally by all competent clinicians that there is no such absolute criterion available."

Clinical observation in the Gastro Enterological Clinic of the Fourth Medical and Surgical Divisions of Bellevue Hospital for the past 8 years, and also on the medical and surgical wards of the Fourth Division makes us question whether a gastric ulcer ever becomes malignant. It is difficult at times to differentiate between an inflammatory lesion and an early ulcerating carcinoma.

Ewing in quoting Verse makes the following statement:

Among 10,000 autopsies twelve early gastric cancers unsuspected during life were encountered. They were usually small, 5 to 5 centimeters in diameter, circumscribed, slightly elevated, sometimes eroded, infected, infiltrated with leucocytes and all were adenocarcinomas. In several cases there was general atrophic or hyperplastic gastritis and a history of alcoholism. It is thus apparent that gastric cancer often begins as a localized overgrowth affecting primarily previous normal cells which show atypical overnutrition and overgrowth and that infection, erosion and ulceration may supervene very early.

Ewing states that he has seen 3 cases at autopsy which presented the above structure. From autopsies on early carcinoma of the stomach the lesion quite closely resembles that of an ulcer.

From the Fourth Medical and Surgical Divisions of Bellevue Hospital.  
Dr. Charles H. Nammack and Carl G. Burdick, directors.

The work of McCarty is familiar to everyone, and he considered 68 per cent of gastric ulcers precancerous lesions. That being the case 2 of 3 gastric ulcers treated by a medical regimen or gastro enterostomy should develop into carcinoma after a few years. From our clinical experience this has not been true. On the other hand, the work of Wilensky and Thalheimer published nearly 20 years ago reports an incidence as low as 1 to 2 per cent. Thus if pathologists differ so widely on this debatable question it is hardly fair to assume that a histopathological study can be taken as authoritative unless the sections are reviewed by several pathologists. Chang in a very recent article states:

It was assumed if the patient showed no signs of cancer after a 2 year observation period the original diagnosis of simple peptic ulcer was correct. On this basis it turned out that 3 of 63 instances of apparent benign ulcer were really malignant or soon became so. This corresponds with current opinion that probably not more than 5 per cent of peptic ulcers show malignant changes.

We will review 118 carcinomas of the stomach which were admitted to the wards of the Fourth Medical and Surgical Divisions of Bellevue Hospital during the years 1928-1935 inclusive, and compare these findings with 104 gastric ulcers which were studied in the Gastro Enterological Clinic of the Fourth Medical and Surgical Divisions during the same period of time.

The 118 patients with carcinomas of the stomach averaged in age 56.7 years, 98 were males and 20 females or 83 per cent in the male sex. The average duration of symptoms before entering the hospital was 45.3 weeks. We realize that the question will be raised as to language difficulty and it can be stated that in only 3 of these cases was it impossible to obtain a history due to this circumstance. It is interesting to note that in reviewing their

symptoms only 7 patients gave a history confusing with ulcer symptomatology. These cases will be briefly elaborated upon later. Of the 118 cases reviewed 38 patients were submitted to operation and in 11 of these a resection was done and in 6 instances convalescence was satisfactory. This gives an operability of 11 per cent. There were 10 gastro-enterostomies performed with 6 deaths. Eleven exploratory operations resulted in 6 deaths. There were 6 ruptured carcinomas of the stomach which were simply closed with subsequent deaths. In other words, there were 38 patients operated upon with a fatality in 23 instances. When it is realized that only 11 resections were done on these patients, one cannot help being impressed with the fact that the disease must have been far advanced before they sought medical relief. This is also borne out by the fact that of the 80 patients not operated upon 32 died while in the medical wards, and in 12 instances an autopsy was obtained. Lahey, in a recent editorial in *SURGERY, GYNECOLOGY AND OBSTETRICS*, states:

In a paper from this clinic dealing with 105 patients with carcinoma of the stomach, the operability was only 22 per cent. That this is not unusual is evidenced by the facts that in the discussion of a recent paper on this subject read by me before the annual meeting of the Pennsylvania Cancer Society, a good sized clinic functioning in a rural section where patients do not seek early investigation for gastric discomfort, reported the operability as only 5 per cent and another group as 7 per cent.

We have excluded a number of questionable cases of carcinoma of the stomach as there were not sufficient roentgenological and laboratory data to make a definite diagnosis. The patients included have been either operated upon, an autopsy has been performed, or else roentgenological studies and laboratory data were sufficient material on which to make a positive diagnosis.

The short duration of symptoms in this group of patients is most disconcerting and makes one wonder if carcinoma ever arises on an ulcer basis. There were several patients in whom the history was sufficiently long to raise a question of doubt.

**CASE 1** Female, 52 years of age, gave a history of gastric distress dating back for a duration of 10

years although her symptoms had become greatly exaggerated for 12 months prior to her admission, but had never been treated for ulcer. An exploratory laparotomy revealed a large carcinoma of the lesser curvature of the stomach with some pyloric obstruction and a gastro-enterostomy was done.

**CASE 2** Male, 62 years of age, was admitted with a history of several years' duration of gastric discomfort, and 2 years before coming under our observation, as a result of roentgenological study in another hospital, duodenal ulcer was diagnosed and the patient was treated for it. After entering Bellevue Hospital the patient was found to have an infiltrating carcinoma of the lesser curvature and operation was advised, but the patient refused and left the hospital at his own request.

**CASE 3** Male, 56 years of age, complained of stomach symptoms for 6 years, had taken medicine himself but never had been under medical treatment until entering Bellevue Hospital. Roentgenological reports revealed an advanced infiltrating carcinoma of the lesser curvature. At laparotomy the condition was found inoperable.

**CASE 4** Male, 71 years of age, complained of stomach symptoms for 7 years before admission and had never been under medical treatment. On admission he was found to have a carcinoma of the pyloric end of the stomach. A laparotomy was performed, but the condition found inoperable and the patient died as result of the exploration.

**CASE 5** Male, 65 years of age, complained of stomach symptoms 24 months before entering the hospital. Roentgenological study revealed a carcinoma of the lesser curvature of the stomach. Operation was performed and he was found to have an inoperable carcinoma of the lesser curvature with pyloric obstruction, a gastro-enterostomy was done.

**CASE 6** Female, 54 years of age, complained of stomach symptoms dating back 2 years but never treated for same. Roentgenological report revealed a carcinoma of the pyloric end of the stomach and a laparotomy revealed the presence of an inoperable growth.

**CASE 7** Female, 38 years of age, with stomach symptoms for 6 years. She had taken medicines given by doctors but had never been subjected to roentgen ray therapy. Roentgenological study revealed carcinoma of the lesser curvature, a laparotomy was performed and a complete gastrectomy was done with death of patient.

It should be made clear that the average duration of symptoms of 45 3 weeks which includes the above cases means that any number of patients came in with symptoms of only 1 to 3 months' duration, the average being approximately 10½ months for all cases. Of these 7 cases with a long gastric history only 1 case had been studied roentgenographically and in that case a duodenal ulcer was demonstrated.

The following case will be cited to reveal how another hospital may be misled by a patient's own statements unless his previous hospital records and roentgen rays are reviewed.

A male, 40 years of age, was admitted to Bellevue Hospital with a history of epigastric discomfort for 6 months and in the 4 months before admission he had lost 15 pounds in weight. A clinical diagnosis of carcinoma of the stomach was made and roentgenograms revealed a carcinoma of the pyloric end of the stomach and an operation was advised. He was transferred to the surgical ward but refused to submit to an operation. He left the hospital in September 1933 and was followed in our clinic for a period of 1 month during which time we tried to persuade him of the advisability of a laparotomy. Fifteen months later in December 1934 he entered St Vincent Hospital in New York and a resection was done. He informed that hospital that he had been treated for an ulcer by us, and he subsequently returned to our surgical ward in December 1935 and died January 1936 with a generalized carcinoma totis.

This case is cited to illustrate how, in a definite carcinoma of the stomach diagnosed clinically and roentgenologically, the patient went for a period of 15 months before a resection was performed and then lived 13 months following the radical operation. This man was 40 years of age with a history of gastric disease of short duration, and one would hardly have expected such a slowly growing carcinoma in this instance.

So much emphasis has been placed on gastric ulcer as a forerunner of gastric carcinoma that a review of 104 cases of gastric ulcers which have been observed in our clinic during the past 8 years will be made. In our clinic during the past 8 years we have observed 761 ulcers and of this number 104 ulcers were gastric and 657 were duodenal. A percentage of ulcers of the stomach of 13.8. This relatively small percentage of peptic ulcers being gastric, makes one realize that those patients suffering from peptic ulcer have an 86 per cent chance that they will not have a carcinoma as the lesion is in the duodenum.

In 104 gastric lesions the average age was 47 years, there were 12 females and 92 males. The ulcer symptomatology of these patients averaged 4½ years before coming under our observation, and they have been followed for an average of 19 months. When the symp-

toms which were present previous to admission to the clinic are added to their follow up it dates the duration of their disease for an average of 6 years.

I feel that the pyloric ulcers should be briefly discussed as Holmes and Hampton have emphasized that in the vast majority of instances an ulcer within 1 inch of the pylorus is likely to be carcinomatous. For that reason the importance of operating upon the prepyloric ulcers to prevent carcinomatous degeneration is now being emphasized. We had 18 cases of pyloric ulcer, or 17 per cent of the total gastric lesions encountered in this locality. The average age was 43 years and the symptoms extended over 25 months before patients entered our clinic. The cases have been followed for an average of 15 months and from clinical observations we do not feel that a patient suffering from prepyloric ulcer runs any risk of carcinomatous degeneration. The roentgenologist may confuse an early prepyloric carcinoma for an ulcer but if the history is considered with the roentgen ray findings one need not be unduly alarmed over carcinomatous changes. The gastric lesions that have been confusing in our series 9 in number, will be reviewed later in the paper. In the entire group of ulcers numbering 761 during the years 1928 to 1935 inclusive there have been 14,232 visits, or an average of 18 visits per patient which gives us a fair opportunity to appraise our results from a clinical standpoint.

There were 16 gastric ulcers which were operated upon, and of these, 9 resections, 5 gastroenterostomies, 1 exploratory laparotomy in which an inoperable carcinoma was found, 1 axillary biopsy. In only 10 other patients was an operation advised but refused. These operations were advised not in fear of carcinomatous changes due to persistent pain from which the patient was suffering which could not be controlled by dietary and other medical management.

There have been 9 cases in this group in which the history or roentgenographic findings suggested the possibility of a carcinoma and these cases will be briefly enumerated.

CASE 1. Male 50 years of age gave a history on admission to the clinic of epigastric distress and the

loss of 25 pounds in weight in the past 3 months. His symptoms had followed pneumonia in May, 1935, and he was admitted to our clinic in late August of 1935. Gastro-intestinal series revealed a lesion of the lesser curvature, and it was reported as a gastric ulcer but malignant degeneration could not be excluded by the roentgenological department. On questioning this patient, he gave a history of having had ulcer symptoms and having been in a hospital for treatment for an ulcer 12 years previously. He had been well since that time, however, until his present complaint.

In view of the roentgen ray findings and history, it was felt that he had a carcinoma of the lesser curvature. A laparotomy revealed a freely movable lesion of the pars media, 2 centimeters in diameter. It gave the impression of being inflammatory and not a carcinoma. A resection was done and the lesion proved to be an ulcer and not carcinomatous. This patient has been followed for 9 months and is perfectly well.

CASE 2. Male, 58 years of age, with gastric symptoms dating back for 1 year with the loss of 25 pounds in weight. A clinical diagnosis of carcinoma of the stomach was made. The roentgen ray diagnosis was pyloric ulcer. This patient was extremely emaciated and there were enlarged lymph glands in the axilla and in the supraclavicular region. A biopsy from one of the axillary glands revealed a metastatic carcinoma. This patient died in the medical ward of the hospital.

Clinically there was never any question of this case being a malignancy of the stomach but the roentgenological report favored a diagnosis of ulcer. The outcome of the case, however, revealed that the clinical diagnosis was correct.

CASE 3. Male, 42 years of age, admitted to the clinic in June, 1928, with a history of epigastric distress dating back 1½ years, with 2 negative gastro-intestinal series, 3 months previous to admission he was operated upon for epigastric hernia without relief of his symptoms. Following this operation a third gastro-intestinal series revealed a prepyloric ulcer. He was under treatment from June, 1928, and after a few months on dietary management he became symptom free. But in May of 1929 his symptoms returned, and at that time he had a lesion on the lesser curvature of his stomach at the pars media, and this was diagnosed as a gastric ulcer. He was treated for another 6 weeks in our clinic and left our observation, but was operated upon in St. Vincent's Hospital in Worcester, Massachusetts, in August of 1929 and was found to have a large carcinoma of the lesser curvature. A gastro-enterostomy was done. This particular case had 2 gastric lesions, the prepyloric ulcer was cured and reported healed by the roentgenological department. The lesion that appeared on the lesser curvature was a primary carcinoma which grew rapidly and bore no relation to his original ulcer.

CASE 4. Male, 40 years of age, complained of epigastric distress for 1 year previous to admission. Roentgen ray diagnosis was pyloric ulcer suggesting malignancy, and at operation the patient was found to have a pyloric ulcer. A gastro-enterostomy was done and this patient has been followed for 1 year since his operation, with no clinical evidence of carcinoma.

CASE 5. Male, 40 years of age, with upper abdominal symptoms for 10 weeks. Roentgenological studies revealed an ulcer of the pars media but in view of the patient's age and short duration of symptoms it was felt that he might be suffering from a carcinoma. Laparotomy revealed a freely movable lesion on the lesser curvature in the region of the pars media, with no suggestion of malignancy. A gastro-enterostomy was done and this patient has been followed for 1½ years without any clinical evidence of malignancy.

CASE 6. Male, 48 years of age, had complained of epigastric pain for 11 years. Roentgenograms revealed an ulcer of the pars media. The patient had lost 10 pounds in weight and was having rather severe pain. Medical treatment was instituted for 6 weeks without any improvement and in November, 1933, he was admitted for operation. Roentgenograms taken after entering the hospital disclosed a carcinoma of the stomach. At operation a large mass was found in the lesser curvature the size of an orange which was taken to be carcinoma. The operating surgeon did a gastro-enterostomy, as he felt the patient's condition would not stand a resection, but a resection was to be done at a later date. The patient improved and 6 weeks later when he was re-operated upon the lesion had practically disappeared. A resection was done and the lesion reported to be an ulcer practically healed with no evidence of malignancy. The patient succumbed from the second operation.

CASE 7. Male, 53 years of age, had complained of gastric symptoms for 6 months. Roentgenograms revealed an ulcer of the lesser curvature of the pars media with a defect of the greater curvature. The roentgenological diagnosis was a gastric ulcer but the short history and the defect on the greater curvature suggested that the patient might have a carcinoma. Exploration revealed an inoperable carcinoma of the stomach.

CASE 8. Male, 42 years of age, had gastric symptoms for 5 years. Roentgenograms revealed a prepyloric ulcer and he was treated in the clinic for a period of 12 months. Two roentgenograms taken during that time revealed an ulcer in the prepyloric region but the third roentgen ray series reported malignant changes. At operation the lesion of the pylorus was taken to be inflammatory. Resection of the stomach was performed and the lesion proved to be an ulcer with no evidence of malignancy.

CASE 9. Male, 40 years of age, with epigastric pain dating back 5 months. Roentgenograms revealed an ulcer of the pars media suggesting malignancy, and an operation was advised but refused.

The patient remained under treatment in our clinic for 3 months and his condition improved but he has failed to return for the past 2 years

When one reviews these 9 cases it is seen that in spite of suggestive roentgen ray evidence of malignancy in 7 of these cases, the clinical course since their operations proved them to be benign ulcers. In two instances the clinical diagnosis of carcinoma was made in spite of roentgen ray evidence of an ulcer of the stomach.

Of the 9 questionable cases 6 were operated upon and found to be purely inflammatory lesions and 1 other refused operation while in only 2 of the 9 was carcinoma proved and in these 2 cases the clinical diagnosis was carcinoma although the roentgen ray diagnosis had been ulcer. So in our group of cases we have failed to find 1 case that has given proof that gastric ulcers do undergo malignant transformation. One will always have an element of error in diagnosing carcinoma of the stomach as any other disease. This series of cases certainly does not support the contention that a high percentage of gastric ulcers undergo malignant transformation. The following case will illustrate how difficult it is to be sure of one's diagnosis in all instances.

Male 36 years of age was admitted to our clinic on April 11, 1935, with a history of epigastric pain for 9 weeks. Roentgenological examination on March 20, 1935, revealed a duodenal ulcer with one quarter of the meal retained at the end of 6 hours. The patient was put on a Sippy regimen and in spite of the different medications he continued to have pain for the next 6 weeks. On May 23 he was hospitalized for possible operation. After admission to the wards he felt somewhat better and was discharged on June 14 as the surgical consultant felt that an operation was not indicated at that time although a roentgen ray examination on June 13, 1935, revealed a definite tubular constriction in the proximal portion of the duodenum with a 25 per cent residue at the end of 6 hours. The patient was most conscientious and in spite of adhering to a strict dietary regimen and different medications his pain persisted. On July 16 roentgen ray examination revealed an ulcer in the first portion of the duodenum and marked tenderness. Shortly after his examination the patient's wife became ill and he did not return for several weeks. In September he returned and we attributed part of his pain to his mental anxiety over his wife. He continued to get worse and roentgen ray examination on December 11, 1935, revealed carcinoma of the pars pylorica and

the roentgenological department stated that a re-examination of the other plates revealed the diagnosis as being a malignant lesion and not an ulcer. The patient was operated upon and found to have a large retroperitoneal carcinoma which had practically surrounded the duodenum and had infiltrated the pyloric portion of the stomach. If this patient had been operated upon when hospitalized 6 months before it is possible that the growth might have been enucleated. But at no time looking in retrospect did this patient have an ulcer either of the duodenum or stomach.

It has been our experience that a gastric ulcer responds much more readily and much more lastingly to medical management than do duodenal ulcers. We do not believe that this is generally appreciated by physicians. In only 16 of our patients were operations performed and in only 10 others was surgery advised, which would mean that in only 25 per cent of the gastric ulcers coming under our observation did we feel that the patient suffered sufficient pain or that the question of malignancy was of sufficient importance to advise operation.

Balfour in 1930 published an article which quite conclusively showed that a gastric ulcer clinically followed over a long period of time rarely develops carcinomatous changes. He reported 100 gastro-enterostomies for large gastric ulcers. A gastro-entero-tomy was done because the lesion was so large or fixed that an excision or resection was deemed inadvisable. In these 100 cases after a 10 year follow up there were only 6 carcinomas. The large size of the lesion encountered at the time of operation would make it seem very likely that the 6 patients may really have suffered from a carcinoma. It is interesting in this connection to consider the fact that in spite of all the roentgenological studies of the gastrointestinal tract and all the efforts at early diagnosis of carcinoma of the stomach the incidence of carcinomatous deaths from gastric malignancy does not diminish. If inflammatory lesions are precursors of carcinoma then early diagnosis of gastric ulcer and either dietary management or operative removal should influence the mortality of gastric carcinoma. Dublin in a recent article states

It is my judgment that instead of 27,000 annual deaths from cancer of the stomach and duodenum in this country at large the deaths are now more

likely to be close to 40,000, or about as many as from bronchopneumonia or coronary disease including angina pectoris

And later he adds that gastric cancers constituted 20 per cent of all cancer deaths

Why the mortality from carcinoma of the stomach does not diminish one can better understand by quoting from an article by Seale Harris in which he states

I have to admit in my 30 years' experience in a fairly large private practice devoted largely to chronic gastro intestinal and nutritional diseases of adults, that I have had only one patient with gastric cancer who came early enough for operation to effect a cure, but others who have had larger experience share my pessimistic viewpoint of the curability of carcinoma of the stomach

Lahey states

One not infrequently hears and reads that the way to improve our results of cancer of the stomach is to submit all gastric lesions to radical surgery, in order that a carcinoma may not be overlooked and in order that malignant degeneration of gastric ulcer does not occur This is, I believe, a wrong attitude, and were it employed on a large scale, the operative mortality would at least approximate, if not surpass, the percentage of gastric carcinomas which are missed under the plan of pre operative segregation by frequent roentgen ray observation while under a short period of hospital observation under medical management

His statement is very illuminating when it is compared to one by Seale Harris in an article published the same month

There is very little danger from an exploratory laparotomy and there is a low mortality from gastric resection when the operation is performed by a skillful and experienced surgeon Therefore, it is better to operate on 99 cases of suspected gastric cancer and find none and cure the 100th case when cancer is found, than to wait for a positive diagnosis of gastric cancer before operating, when probably 99 out of the 100 will die even if operated upon

In this instance the medical man is pleading for an early operation and the surgeon pleading for conservatism This leaves one in a state of confusion regarding the rôle of gastric ulcer as being the forerunner of gastric carcinoma

#### SUMMARY

In reviewing 118 gastric carcinomas there was no conclusive evidence that a gastric ulcer is the forerunner of gastric carcinoma

The above cases revealing gastric symptomatology for only 45 7 weeks does not lend to this argument In only 7 cases, as previously stated, was there a long history of gastric complaints Comparing the 104 gastric ulcers, one sees only 9 instances in which there was a reasonable element of doubt as to a gastric malignancy In these 9 cases 6 patients were operated upon with proof that the lesion was inflammatory and in 2 instances in which the roentgenologist had diagnosed an ulcer the clinical diagnosis was carcinoma In one of these cases the diagnosis was proved by a biopsy of an axillary gland and the patient died in the medical ward In the other instance a laparotomy revealed inoperable carcinoma which had from all evidence been a primary carcinoma and had not arisen from a gastric ulcer Therefore, from our cases it would seem safe to conclude that once a gastric ulcer always a gastric ulcer, but realizing that in an occasional case it is difficult to determine whether the lesion is a true benign ulcer or an early ulcerating carcinoma The only way that these questionable cases can be intelligently handled is to submit them to a resection The questionable cases do not constitute over 7 to 8 per cent of those coming under one's observation

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# ECTOPIC URETERAL ORIFICE

## A Report of 17 Cases in Children<sup>1</sup>

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**B**Y anomalous development one or more ureteral orifices may abnormally open at some point other than the lateral angle of the vesical trigone. The relatively few instances of this condition reported in the literature (197 cases) suggest that the anomaly is one of great rarity, 7 cases have been seen at the Mayo Clinic—1/130,000—(3). Yet my experience has been otherwise. Seventeen cases in infants and children<sup>2</sup> are here reported, 9 were urologically examined by me and in 7 of these the ectopic ureteral orifice was seen. All of the 7 clinically discovered anomalies were found during the investigation of young patients subjected to urologic examination because of "chronic pyelitis." In reporting these cases, however, I am less concerned with them as examples of unusual maldevelopment than as clinical findings illustrative of important theses which can be discussed here only by inference. These theses are (1) an anomalous organ is more prone to disease than a normal one, (2) disease in anomalous urinary organs is predominantly some phase of urinary stasis and infection, (3) children with chronic pyuria or persistent disturbances of urination should be subjected to a thorough urologic examination, and (4) with proper attention to pre operative preparation, with due care in the operating room and after operation, radical surgical treatment may be successfully employed even in the extremely young.

### ETIOLOGY

Sex. Ectopic ureteral orifice is twice as frequent in females. In Thom's 185 collected cases, 122 were females, 63 were males. In

the 17 cases here reported, there were 3 males and in them the condition was discovered postmortem. Moreover, according to the literature, the anomaly has been found during life in only 9 males.

Side. In the present series, the anomaly occurred on the left in 11 cases, on the right in 4, and was bilateral in 2.

*Embryologic etiology.* Between the fifth and sixth weeks of fetal life, a frontal fold, the urorectal septum, passes downward to separate the primitive cloaca into a dorsal rectal and a ventral urogenital segment (Fig. 1). From the latter spring the ureteral buds which ultimately form the urinary collecting system. The wolffian ducts open into this vesico-urethral anlagen. Later, the ureteral orifice on each side shifts upward to open into the lateral angle of the trigone, failure to do so results in ureteral ectopy. From the wolffian duct are formed the posterior urethra, vas deferens, epididymis and, by budding, the seminal vesicle. This early anatomic relationship of the ureteral buds and the wolffian derivatives explains certain unusual types of ectopy of the ureteral orifice. In 61 males of the series collected by Thom, the ectopic orifices were in the prostatic urethra 33 times, in the seminal vesicle 17 times, in the vas deferens 6 times, and in the ejaculatory duct 5 times. In 117 females the ectopic orifices were situated as follows: vestibule, 45; urethra, 37; vagina, 32; and uterus, 3 (Fig. 2).

Other associated developmental defects such as unilateral renal agenesis, vesical exstrophy, urethrorectal fistula, and imperforate anus have been notable in the reported cases.

As a rule the ectopic orifice is one of reduplicated ureters. Complete double ureter is said to result from (1) reduplicated ureteral stalks or, more generally accepted, (2) fission or splitting of the usual single ureteral bud. By "inversion" of the reduplicated ureters,

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<sup>2</sup>Six of these patients were admitted to the Babies Hospital and 3 were operated upon by the writer while a member of the Attending Staff of the Hospital. These 6 cases are herewith included by the kind consent of Dr. Rustin McIntosh, medical director of Babies Hospital.

that from the upper renal pelvis opens lowest in the urinary tract and is most often the site of the major disease (Fig 3, F). The ureter from the lower renal pelvis almost always opens in the bladder (Fig 4). Eleven of the cases here reported were of this type. Yet, as indicated in Kilbane's classification, both reduplicated ureters may be ectopic.

If the ectopic orifice is proximal to a competent sphincter muscle there will be no incontinence. In males the clinical picture is predominantly that of urinary infection. In females with ectopic ureteral orifice, incontinence is usually in the foreground and in this sex the clinical diagnosis is likely to be "enuresis" in children and "bladder paralysis" in adults.

#### PATHOLOGY

Kilbane's classification of the various types of ureteral ectopy is adequately inclusive, the numbers in parentheses indicate the incidence of the condition in the 185 cases collected by Thom:

- a Single ureter with ectopic opening (58)
- b Complete unilateral duplication of pelvis and ureter with an ectopic opening of the supernumerary ureter (96)
- c Complete unilateral duplication of pelvis and ureter with ectopic opening of both ureters (2)
- d Supernumerary kidney, pelvis, and ureter with an ectopic opening
- e Bilateral duplication of pelvis and ureters with one ectopic opening only (21)
- f Bilateral duplication of pelvis and ureters with bilateral ectopic openings (2)
- g Both single ureters having ectopic openings (6)

Ectopic ureteral drainage into the rectum is exceedingly rare and is best explained by faulty division of the cloaca by the urorectal septum (Cases 14, 15). In some cases of vesical exstrophy, the ureteral openings may be found in the urethral gutter or in the vestibule. In a 5 year old boy with a congenital solitary right kidney, an attenuated ureteral stump on the opposite side opened into the seminal vesicle (Case 9), Papin and Verliac reported a somewhat similar case. In the older writings, conjunction of the wolffian and muellerian ducts is adduced to explain ectopic

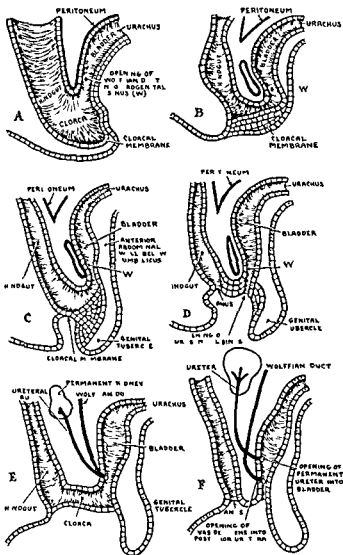


Fig 1 Division of the cloaca into a urogenital and rectal segment. The ureteral buds spring from the former (after Corning).

ureteral openings in the cervix or vagina. Analysis of most cases believed to be of this type reveals that the opening actually was in the vestibule. Yet in a 21 months old girl at Babies Hospital, the right ureter emptied into the posterior vagina, double vagina and bicornuate uterus coexisted. For embryologic reasons, ectopic ureteral orifices do not open into the fallopian tubes or in the canal of the uterus (muellerian duct derivatives).

The urinary tract above the ectopic orifice is almost always dilated. These orifices, however, are usually large, so that urinary obstruction and backpressure are commonly not factors in producing the dilatation. Yet contrary to the findings in the 14 girls in my series, many writers describe the ectopic ori-



Fig. 2 Sites of opening of ectopic ureters in male and female

fice as characteristically small and the cause of the ureteral dilatation above. Although not readily susceptible of proof, it is the writer's belief that faulty neuromuscular development of the anomalous duct is the likely explanation when dilatation of the ureter and pelvis exists. The ureteral musculature is usually thinned and commonly shows inflammatory cellular infiltration and sclerosis. The renal pelvis drained by the anomalous ureter also is usually roundly dilated (Figs 3, 4, 5). Microscopically the parenchymal segment shows tubular dilatation atrophy, and other characteristic changes of hydronephrosis.

Urinary infection exists in fully 90 per cent of the recognized cases of ectopic ureter. In the presence of urinary infection, the renal parenchyma drained by the ectopic ureter shows acute or chronic interstitial suppurative nephritis with, usually, the various changes coincident to infected hydronephrosis. In a 13 months old girl with bilateral ureteral reduplication and ectopic openings of the ureters to the superior pelvis (Fig 6), embryonal cartilage and an embryonal formation of the glomeruli and renal tubules were found in the upper half of the infected hydronephrotic segment removed by heminephrectomy.

#### SYMPTOMS

Patients with ectopic ureteral orifice may be symptomatically grouped according to (1) urinary disturbances and (2) urinary infection.

**Urinary disturbances.** In most cases of ectopic ureter a normal urinary schedule is accompanied by a constant urinary dribbling. This means the external sphincter is inadequate or the ectopic opening is peripheral to the sphincter (Fig 6). Children with this condition are often treated years for enuresis and sometimes adults are. In patients with normal urinary control, and these are less common, the orifice opens behind a competent sphincter. Because the prostatic urethra and the seminal ducts which drain into it are of wolffian duct origin, ectopic ureteral opening

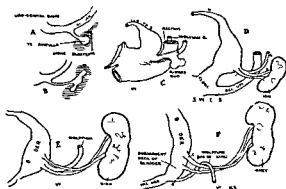


Fig. 3 Embryology of the ureter. A and B Single ureter springing from the wolffian duct. C to F Double ureter formation. Note how by inversion the ureter from the upper pelvis comes to open lowermost.



Fig 4 Ectopic ureteral orifice in a 5 year old girl with renal reduplication (Case 7, Table I) A, Pre operative pyelogram A normal lower renal segment is suggested by a normal lower pelvic urogram and indicates the desirability of renal resection B, Schema of indications found At the first operation heminephrectomy and partial ureterectomy were performed Two months later the remaining pyo ureteral segment of the resected ureter (cross shading) was excised C, Retrograde pyelogram of remaining ureter and renal pelvis 1 month following renal resection

into these passages does not interfere with urinary control Males, therefore, stay dry

Bizarre histories of urinary control have been recorded Nové-Jossierand's patient was incontinent only in the upright position Judd's patient, a 21 year old girl, was incontinent by day during her entire life but at night only during the first few years In Kallmann's case, the incontinence of early years later disappeared without treatment On the other hand, in Fromme's patient, there were no urinary symptoms until adult life, leakage of urine followed childbirth Finally, as in the cases of Erlach and of Kolisko, the condition may be asymptomatic and require no treatment

*Urinary infection* Persistent pyuria was the indication for urologic investigation in my

seven clinically recognized cases of ectopic ureteral orifice in children In 2 additional cases, a 13 months old girl and a 5 year old boy each examined because of chronic pyuria (Case 8, 9), the anomaly was not discovered until postmortem examination Ectopic ureteral orifice, therefore, indicates but another of the legion of conditions which may masquerade under the pathologically inadequate clinical designation chronic pyelitis In my patients thus examined the major site of infection was the anomalous urinary segment, the excision of which was the principal step in eliminating the infection The youngest child was 6 months old (Case 2) If the infected ureter opens into the urethra, the bladder urine is certain to be infected The drainage from the ectopic ureter may be mildly in-



Fig 5



Fig 7

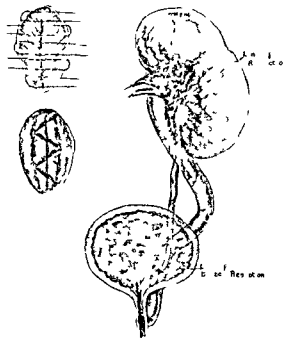


Fig 6



Fig 8

*Legends on opposite page*

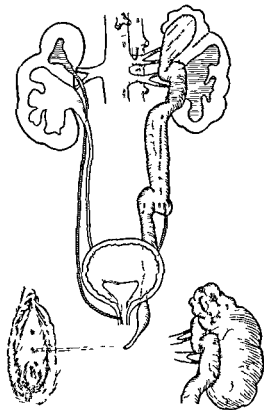


Fig. 9 Bilateral ureteral ectopia and bilateral complete ureteral reduplication. Schema of conditions found in a 13 months old girl examined because of "chronic pyelitis." The upper renal segment drained by the ureter which opened into the posterior urethra was not infected. The corresponding segment on the left showed advanced infected hydronephrosis and the ureter opened into the vestibule. Squeezing the upper left loin caused thick pus to discharge from the ectopic ureteral orifice. Uretero-heminephrectomy. The ureter was removed down to within 3 centimeters of its opening in the vestibule. In the lower lefthand insert is indicated the wrinkled atrophic condition of the parenchyma surrounding the hydro-nephrotic upper pelvis.

ected, thickly purulent or dense, mucoid. If the ectopic opening is in the vestibule, a catheterized bladder specimen may be normal. Yet contamination of the voided specimen by the ureteral discharge into the vestibule should direct attention to the urinary tract. An exacerbation of the smoldering urinary infection might be recognized as "acute pyelitis."

Fig. 5 Ectopic ureteral orifice in a 5 months old female urologically examined because of persistent pyuria. Anomalous upper tract injected with radiopaque medium through a small urethral catheter. The intention was to obtain a cystogram. The catheter entered the ectopic ureteral orifice.

Fig. 6 Schema of conditions urographically demonstrated (Fig. 7) and surgically disclosed (Fig. 5). Uretero-heminephrectomy.

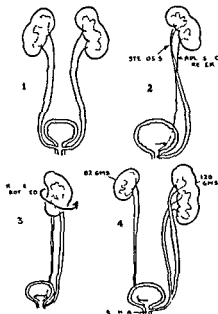


Fig. 10 Ectopic ureteral orifices as found at autopsy. 1, female, 6 months, 2, female, 10 months, 3, male, 1 month, 4 female 8 years.

#### DIAGNOSIS

The persistence of disturbances of urination or of pyuria in either a child or adult demands a thorough urologic investigation. Excretory urography (1) may yield a suggestive clue when ureteral reduplication is revealed but two isolateral orifices are not found in the bladder, and retrograde pyelography proves that incomplete ureteral reduplication does not exist. In chronic pyuria 2 normally situated ureteral orifices ejaculating normal urine may be found in the bladder and, as in 6 of my clinical cases, the ectopic orifice ejaculating purulent urine will be found in the urethra. In Case 4 the purulent ejaculation was into the vestibule (Fig. 6).

Following the intravenous injection of indigocarmine, the diagnosis is comparatively simple if the urethra, vestibule, vagina, and rectum are inspected for the blue urinous discharge. If the bladder is filled with a solution of methylene blue, perineal pads will not be stained even though an ectopic ureteral orifice

Fig. 7 Retrograde urographic injection of both reduplicated pelvis in same case as in Figure 5. Note the lower pelvis appears normal. The upper and lower pelvis are sufficiently separated to encourage heminephrectomy. Normal right pelvis.

Fig. 8 Normal appearing pelvis of remaining lower half of kidney (Case 6, Fig. 5). This pyelogram was taken a few months after operation was performed. The patient was cured.

TABLE I—ECTOPIC URETERAL ORIFICES SUMMARY OF 17 CASES IN AUTHOR'S SERIES

Case Age Sex	Side	Ectopic ure- ter redup- licate?	Site of orifice	Pyuria	Treatment	Comment
1 36 months F	Left	Yes	Mid urethra	++++	Operation refused	Still pyuria
2 6 months F	Left	Yes	Mid urethra	++++	Ureteroheminephrectomy	Cured* Growth normal and urine sterile 4 years later
3 22 months F	Right	Yes	Deep urethra	++++	Ureteroheminephrectomy	Cure! Urine sterile Normal development
4 13 months F	Bilateral	Yes	Rt Deep urethra Lt Vestibule	++++	Left ureteroheminephrectomy	Infection cured but recurred in 6 months Died 2 years later fibro- sarcoma of scapula
5 18 months F	Left	Yes	Mid urethra	++++	Ureteronephrectomy	Cure! Urine sterile Normal development 3 years later
6 5 months F	Left	Yes	Deep urethra	++++	Left ureterohem nephrectomy	Known to have mild B coli; infect on 6 months postoperative Otherwise normal
7 3 years F	Left	Yes	Deep urethra	++++	1. Heminephrectomy and excision of upper 1/4 of ureter 2 Six weeks later excision of ureteral stump (pyoureter)	Infection cured within 3 months Moderate vaginitis
8 13 months F	Right	Yes	Anter or urethra	++++	Bilateral ureterostomy	Operation because of bilateral ureteral obstruction (ureterovesical junction stricture) Died of urinary sepsis and renal failure Ectopic ureteral open- ing found postmortem
9 5 years F	Left	No	Blind ending in seminal vesicle	++++	Autopsy Died of measles Urethrorrectal fistula rectal structure urethral calculi. The cystoscopic diagnosis of congenital solitary right kidney was confirmed postmortem The left ureteral stump (about 4 cm long) opened into the left seminal vesicle	
10 4 10 months F	Bilateral	No	Mid urethra	?	Autopsy findings are shown in Fig 7 (1)	
11 10 months F	Left	Yes	Mid urethra	?	Autopsy findings are shown in Fig 7 (2)	
12 12 months M	Left	Yes	Prostatic urethra	?	Autopsy findings are shown in Fig 7 (3)	
13 8 years F	Left	Partial	Mid urethra	++++	Autopsy findings are shown in Fig 7 (4) Hypoplastic right kidney	
14 6 weeks M	Left	No	Rectum	++++	Right ureter and impervious cord springs from lower pole of hypoplastic right kidney Rectal atresia urethrorrectal fistula dilated rectum Left pyonephrosis dilated left ureter opens into lower rectum	
15 36 months F	Right	No	Rectum	?	Autopsy Left ureter ended blindly at bladder wall bladder e strophy	
16 9 months F	Right	No	Vagina	++++	Also vesicovaginal fistula double uterus double vagina	
17 3 days F	Left	Yes	Urethra	++++	Also imperforate anus atresia of duodenum ileus and pyuria	

\*Cured as judged by absence of pyuria and two sterile cultures of catheterized specimens

exists, and will be stained if there is true vesical incontinence. The correct diagnosis is made more often in females because the condition is more common in this sex and ureteral orifices in the vestibule are likely eventually

to be recognized. In a 13 months old girl, squeezing of the upper half of the left kidney caused the ejaculation of a toothpaste like ribbon of purulent urinary debris from the ectopic orifice in the vestibule (Fig 6)

## TREATMENT

If the ectopic ureter is the only one for the kidney, transplantation to the bladder (ureteroneocystostomy) is indicated in the absence of marked infection. In the presence of important infection of the anomalous segment and if the condition of the opposite kidney permits, ureteronephrectomy is the usual indication. If the opening of the ectopic ureter is from one of two reduplicated ureters and only the ectopic segment is diseased, ureteroheminephrectomy should be carried out. In a young woman without important disease of the upper renal segment drained by the ectopic ureter, Foley partially resected the upper third of the ectopic ureter and ligated the distal stump. He then implanted the short proximal stump into the normal lower pelvis (ureteropyelostomy). In a child, however, the small parts render such a procedure technically far more difficult and doubtless less satisfactory than ureteroheminephrectomy. When the segment of parenchyma drained by the ectopic ureter is small and uninfected, several writers advocate ligation of the anomalous ureter. My choice is renal resection. If both renal segments are surgically diseased and the opposite kidney is adequate, nephrectomy is the treatment of choice. When nephrectomy alone would leave a large dilated ureter, perform ureteronephrectomy (Figs 3, 4, 5). In my clinical series, ureteroheminephrectomy was carried out five times, ureteronephrectomy and bilateral ureterostomy each once, and operation was refused once. The youngest patient to have renal resection was 6 months old. All survived. Four are known to be bacteriologically cured (two negative cultures of catheterized specimens). In another child, temporarily cured, reinfection subsequently occurred (Case 4). Two years later fibrosarcoma of the scapula developed.

## SUMMARY

Seventeen cases of ectopy of one or more ureteral orifices are reported. The patho-

logical embryology is discussed. The important clinical manifestations may be (1) disturbances of urination or (2) chronic pyuria. The former, in a child, usually leads to the diagnosis, enuresis, the infection is regularly designated chronic pyelitis. The usual treatment employed for the respective conditions fails for obvious reasons. This failure is the indication for a thorough urologic examination. Radical urosurgical treatment is required.

Table I demonstrates the fact that with adequate recognition of the prophylactic and technical requisites of surgical treatment, even young infants may receive the benefits of modern urologic knowledge (2).

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# THE TREATMENT OF CANCER OF THE CERVIX UTERI AT THE RHODE ISLAND HOSPITAL

## A Report of 293 Cases with 5 Year Follow-Up<sup>1</sup>

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**B**EFORE proceeding with our report we should like to speak briefly of some theories of radium action and some methods of practice in radium therapy. In spite of the fact that in the primary treatment of cancer of the cervix radical surgery has been supplanted by the use of radium in all but a few clinics where able surgeons learned their technique in the days before radium became more generally available, there still remains the problem of how to use radium to get the best results. This problem is not a simple one as is appreciated by all who have tried in some way to solve it. The ways of using radium are varied as is found by visiting different clinics and by reading reports from different clinicians. Since methods today are usually based on some sort of theory or reasoning and are not entirely empirical as they may have been in the past, it might be well to consider first some of the *fundamental principles on which modern methods are based*. This should give a clear idea of what is expected from radium.

1 That radium may be used as a *caustic agent* is quite true and that with sufficient intensity or strength of applicator and sufficient time factor the tumor can be sloughed out is a many times proved fact.

2 That radium in proper relation as to intensity of applicator and time factor can cause the disappearance of a tumor without slough is also a many times proved fact. Furthermore, that this disappearance of the tumor under such favorable conditions of exposure can occur without serious damage to surrounding tissue is proved to be possible. In fact, such a result has become the aim of all modern radium treatment. This phenomenon of disappearance of tumor cells and of non-injury of normal cells has been attributed to a so-called selective action of the hard  $\gamma$  rays of radium and the short wave length  $x$  rays. There is apparently a wide difference in sensitivity to the rays between normal living cells and rapidly growing cancer cells, the more atypical or anaplastic type, whose rapid growth is attested by

frequently occurring mitotic figures being much more sensitive than the more adult types. Hence we speak of radiosensitive tumors and of radio-resistant tumors, the radio-resistant types as a rule more nearly approaching the normal adult cell in sensitivity and requiring for their disappearance doses which more nearly approach the dangerous zone of sensitivity for normal tissues.

3 That  $\gamma$  radiation may have in addition to this direct selective action on the tumor cell another more *indirect action* is suggested by Hector A. Colwell in his prize essay on 'The Method of Action of Radium and  $x$  ray on Living Tissues'. (3) Commenting on the work of Russ, Chambers, and Scott on animal tumors, he says:

The experimental fact that tumor cells irradiated while growing in a rat and left undisturbed after radiation are much less likely to grow than if they are removed and injected into another rat certainly suggests that the environment of the implant is not without effect (Chap. vi pp. 143, 142). The experimental work of Russ, Chambers, and Scott strongly points to the production of some factor or factors which inhibit tumor growth and that such factor or factors appear during the destruction of cancer cells. If this is the case the treatment of neoplasms of highly malignant and metastasizing type by small individual foci of highly filtered  $\gamma$  radiation for a considerable period would seem to offer the best means for the formation of such antibodies. Obviously if such bodies exist their slow formation and escape from the injured cells will be more effective in favoring the destruction of microscopic metastases than will single, highly intensive doses whereby the cancer cells are rapidly destroyed. The field is a very tempting one for speculation and perhaps in the fairly near future more light may be shed upon it by experiment and the statistical records of the results of radiation treatment.

In this quotation a suggestion is made as to the use of small foci, heavy filtration, and long time interval, which we feel is quite significant and which we think our results bear out.

Let us now consider methods. There are three ways in which the  $\gamma$  rays can be effectively used in treating cancer of the cervix: (1) *Surface radiation*, i.e., the application of packs, tubes, bombs, plaques, or boxes containing tubes against the surface of the cervix or vaginal vaults and into the canal; (2) *Interstitial radiation*, i.e., the

<sup>1</sup>Read before the Boston Obstetrical Society, February 18, 1936.

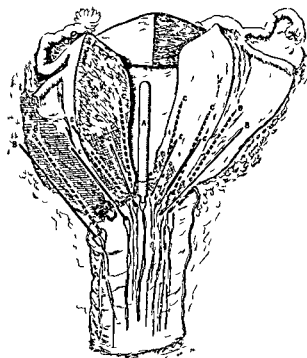


Fig 1

Figs 1-3 A, 20 milligrams platinum filtered tube, B 3 milligrams platinum needle, C, 2 milligrams platinum needles

Fig 1 Lined area indicates advancing parametrial invasion, cross hatched area cervical tumor, dotted needles are posterior to midline of cervix

Fig 2 Method of inserting needles anteriorly and posteriorly

Fig 3 Lined area shows cervical tumor dotted line shows area of paracervical invasion

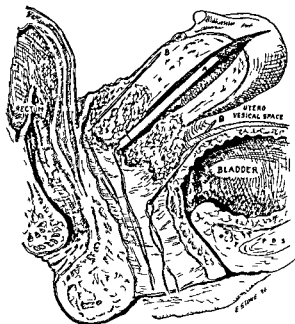


Fig 2

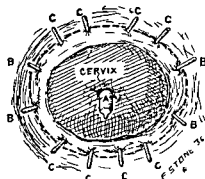


Fig 3

insertion of seeds of radon or of radium needles into the tumor tissue itself—called radium puncture, or (3) distance radiation—tele-radium or x-ray, i.e., the employment of x-ray at a distance or of radium pack containing a large quantity of radium, e.g., 2 to 4 grams. With the latter method, this paper is not particularly concerned as in very few of the reported cases did the patients have x-ray treatment and most of those had it only as a last resort and it was not used as a part of the original treatment.

Surface radiation is in use in most European clinics and perhaps in the majority of clinics in this country. A few clinics here use interstitial radiation as part of the primary uniform treatment—notably Ward, of Woman's Hospital, who uses short needles of 12 to 13 milligram intensity. The use of interstitial radiation, and particularly of the long needles has not been thought well of, but to my knowledge the "long needles and low intensity" method has never been tried

out over a sufficiently long series of cases to give a fair test as to its value. The great objection seems to be fear of infection from thrusting the needles through potentially infected tissue, a fear we find to be more theoretical than real.

The differences of technique as to surface radiations revolve about the question of intensity and time factors. The question of filtration is apparently settled, all clinics now favoring heavy filtration equivalent to 2 to 3 millimeters lead.

1. High intensity—short time interval. This method is practiced for instance at the Memorial Hospital in New York by Dr. Healy. He uses about 3000 millicurie hours in the vagina, by means of a 1000 millicurie bomb for 1 hour in 3 directions, against the cervix and against each lateral fornix. In addition he uses a tandem of 2 tubes (200 millicurie in lower segment and 100 millicurie above in cervico-uterine canal for 10 hours). External radiation x-ray is then used some weeks later.



Fig. 4 \ ray plate of needles and cap in place  
Dense area shows iodoform packing in vagina

2 *Medium high intensity—longer time interval—interrupted treatment* This is the method at Radium Hemmet Stockholm and in most English hospitals. Here the same total dose used by Healy is employed but divided into 2 or 3 fractions. Each treatment consists of the application of about 40 milligrams in tubes in the uterus, and 80 milligrams in the vagina in standard boxes with an average time interval of 20 hours. The first 2 treatments are 1 week apart, the last 2 treatments 2 weeks apart. In all 60 hours in time with an intensity of 120 milligrams and total dosage of 6000 to 7000 milligram hours.

3 *Low intensity—long time interval—Paris Institut—Regaud and Lacassagne method* Regaud was perhaps the first to advocate small, well distributed heavily filtered foci for a protracted time interval i.e., 5 days, and continuous application except that he removes the tubes and after cleansing replaces every 24 hours. He uses 2 tubes (1 millimeter platinum filtration) of 133 milligrams radium element and 1 tube of 666 milligrams in the uterus and the same size tubes in vagina except that the filtration here is 15 millimeters. His average time interval is 5 days' continuous treatment of 120 hours. He attains a total dosage of about 8000 milligram hours, equally distributed in vagina and uterus 33 milligrams in each.

4 Most American clinics using radium in surface applications use somewhat less filtration— $\frac{1}{2}$  millimeter silver plus 1 millimeter brass or

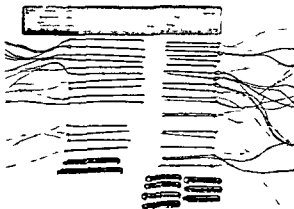


Fig. 5 Radium available as described in text

2 millimeters brass—and get a total dosage of about 3000 to 5000 milligram hours in 2 or 3 treatments.

In the November, 1930, *American Journal of Obstetrics and Gynecology* we published our first report covering 92 cases with 5 year follow ups, treated from 1921 to 1924. Since then we have added 1 more case to this group, a Stage IV, bringing the total to 93. This case was a private patient of one of us and by some oversight was not included in the original number. We have since then traced 1 case, of the 1921 group, and found that the patient was still alive in California 10 years after treatment, and a second, of 1922 group died at the Rhode Island Hospital in 1934 of cancer and cardiac disease 12 years after treatment. We can, therefore, add 2 to our 5 year survivals for that group which makes 18 out of 93 instead of the 16 reported.

In this first report we gave a brief sketch of the origin of our clinic of the radium available to us at the time, and of our method of application. I will briefly restate the pertinent facts.

The Rhode Island Hospital received through the generosity of a benefactor, a supply of radium in 1921. The trustees immediately made it a policy to restrict the use of radium to a certain group of men representative of the surgical specialties thereby making this clinic and its work possible. Pitts was made responsible for the use of the radium in gynecological cases and early in 1923 Waterman was appointed as his assistant. The radium clinic of the gynecological department was then organized, and has functioned continuously since under the same leadership except that now we have another assistant DiLeone. All previously treated cases of 1921–1922 were looked up, and booked in this clinic, a part time secretary was granted to keep our records, and a

social worker assigned to help with our follow-up. This clinic met twice a week for the first few years but now meets once a week on Wednesday after noon. Both of us have from the first made it our special duty to be present at all meetings of the clinic, as well as at all operations on clinic patients no matter which of us is operating. To this clinic are referred all cases of gynecological malignancy from the out-patient department or the wards of the hospital. A history is taken and a preliminary examination made. If the case is clinically diagnosed as malignant it is referred to be admitted to the ward. The patient is then prepared for operation after the usual preliminaries, history, and complete physical examination with blood and urine examinations have been done. All treatment is carried on in the operating room. Here we have excellent light, complete relaxation under general anesthesia—gas oxygen with a little ether if necessary—and resultant good exposure. We have felt that under these ideal conditions we could make a careful examination as to the extent of the disease and could place our radium to the best advantage. In addition we do not have to worry about causing pain or discomfort to our patient. At this time we also take a specimen for microscopic examination.

At the time of operation we dictate a careful description of the growth and its extent and give our opinion as to its clinical stage. We use the method of clinical classification according to Schmitz. This method seems to us simple, easy to understand, and one which offers the best chance of being interpreted practically in the same way by different examiners, e.g., Stage I represents the early nodule, less than one-half of one lip of the cervix. Stage II represents extension up to total involvement of the cervix, but without extension to vaginal wall or loss of mobility of cervix. Stage III represents extension beyond the cervix with distinct loss of mobility, paracervical infiltration and perhaps some involvement of one side of parametrium. Stage IV represents absolute fixation of cervix and uterus with involvement of both parametria—"frozen pelvis,"—or extensive involvement of the vagina with possible fistula formation. Stage V represents recurrence after treatment elsewhere—cases which have almost always been hopeless and have been included in the Stage IV column in our series. We have not attempted to reclassify our cases according to the League of Nations formula.

#### METHODS OF TREATMENT EMPLOYED

As regards methods of treatment we can separate our cases into 2 periods of 5 years each. The

first period extends from 1921 through 1925 and comprises 120 cases, the second from January, 1926, through 1930 and comprises 173 cases.

In the earlier group our treatment was restricted by the form in which we found our radium. We had what I suppose at that time was considered adequate radium in appropriate form for general hospital use. That is, we had three 50 milligram tubes and two 25 milligram tubes of standard size.<sup>1</sup> The radium was contained in a glass cell inside a silver tube of  $\frac{1}{2}$  millimeter thickness. This tube was in turn placed inside a brass capsule of 1 millimeter wall thickness. In addition to these tubes we had 10 needles of 5 milligrams each, the needles being made of some alloy, but commonly called steel. Our plan in the first cases was to deliver a total dose of 3000 to 4000 milligram hours in 2 or 3 treatments 2 or 3 weeks apart. We placed 2 of our 50 milligram tubes filtered by silver and brass in a rubber tube in tandem in the cervico uterine canal. The remainder of the radium, i.e., one 50 milligram and two 25 milligram tubes and the 10 steel needles we either made into a pack and placed against the cervix, or in many cases used the radium needles interstitially, thrusting them into and about the growth.

In 1925 while in London, Dr. Pitts saw Dr. Malcolm Donaldson at St. Bartholomew's Hospital using some long platinum needles. These needles were being placed partly through the vagina and partly by the intraperitoneal route. The method is described in Carl Davis' 3 volume *Obstetrics and Gynecology* as originating in the clinic of Delporte and Cahan in Belgium. On a visit to St. Bartholomew's in the summer of 1935 we found that Donaldson had given up this method entirely as being too dangerous, and it is certainly much frowned upon in France. However, we considered the matter carefully during the summer of 1925. It seemed to us that there might be possibilities in the use of these needles. It had been shown, especially at Regaud's clinic in Paris, that multiple foci of radium widely placed, of low intensity with a heavy filtration and a long time interval gave excellent results both as to the disappearance of the cancer cells, and as to the recovery without serious damage of the normal cells. It had always seemed to us that the logical place to treat infiltrating types of cancer such as occur in the cervix was in the paracervical and parametrial tissues where the cancer was advancing. Why was it not more sensible to lay down multiple small foci all about the zone of advancement out where the active infiltration was

<sup>1</sup> Provided by the Radium Chemical Company

TABLE I—SURVIVALS BY CLINICAL STAGE—TOTAL 1921-1930

Stage	Total	1	2	3	4	5	Percent	Percent	Operability	Died of Ca in 6th year	Survival 6 yr—symptom free after 5 years	Percent
I	14	14	13	13	13	13	92.8	62.3		2	11	78.5
II	71	66	54	47	44	40	56.3			1	33	53.5
III	105	79	49	37	26	24	22.8			4	20	19
IV	103	19	7	3	3	2	1.9			0	2	1.9
Total	293	78	121	94	86	79	26.0		29	8	71	24.2

TABLE II—SURVIVALS BY CLINICAL STAGE—TOTAL 1921-1925—FIRST METHOD—BRASS CAPSULES STEEL NEEDLES

Stage	Total	1	2	3	4	5	Percent	Percent	Operability	Died of Ca in 6th year	Symptom free after 5 years	Percent
I	4	4	4	4	4	4	100	69.6		0	4	100
II	19	18	17	15	13	12	63.1			1	11	57.9
III	45	28	12	7	6	6	14			3	3	6.9
IV	54	1	7	3	3	2	3.7			0	2	3.7
Total	122	67	40	29	26	24	20		19.1	4	20	16.6

TABLE IIIA—SURVIVALS BY CLINICAL STAGE—TOTAL 1926-1930—SECOND METHOD—LONG NEEDLES—LOW INTENSITY—LONG INTERVALS

Stage	Total	1	2	3	4	5	Percent	Percent	Operability	Died of Ca in 6th year	Symptom free after 5 years	Percent
I	0	10	9	9	9	9	90	59.6		2	7	70
II	52	48	35	33	31	28	53.8			1	27	51.9
III	62	51	37	24	20	18	29			1	17	27.4
IV	49	2	0	0	0	0	0			0	0	0
Total	173	111	81	65	60	55	31.8		15.7	4	51	29.3

Note the ease in survival rate Stage III 6.43 to 28.62 14 per cent to 29 per cent

taking place? We could see but one objection and that was one of possible infection. Would we get infections of the broad ligament or possibly peritonitis? We thought we had better try. Our new needles and a 20 milligram platinum capsule arrived in early 1926 and we started on the second phase of our experience.

We have now in addition to the 50 milligram and 25 milligram tubes

	Active Length	Wall
2—20 mgm tubes	36-40 mm	5 mm platinum
20—2 mgm needles	30 mm	5 mm platinum
10—3 mgm needles	45 mm	5 mm platinum
4—4 mgm needles	39 mm	5 mm platinum

We tried a few cases of combined vaginal and intraperitoneal implantation but soon saw that the abdominal part was impractical as a routine method. We found that we could implant our long needles in the parametria and out into the broad ligament and in the vesicovaginal and rectovaginal septum without any difficulties or untoward

effects. And we thought that there was not so much of slough and breaking down of tissue and that the cervix returned to normal appearance sooner under this treatment. Our plan was to place four 3 milligram needles out into the tissues at the sides of the uterus, 2 needles on each side. We then thrust the 2 milligram needles at 1 to 2 centimeter intervals front and back of the cervix using in all about 12 to 16 needles. In the cervical canal we placed the 20 milligram platinum capsule holding it in place with a strand of silkworm gut or in many cases we still used our tandem of 2 of the 50 milligram tubes.

During the first 3 years, between 1926 through 1928, where we used all platinum containers we left the radium in place for 72 to 96 hours. In the years 1929-1930 we increased our time interval from 72 to 96 hours to on an average of 144 to 168 hours and it would seem that we have attained some measure of improvement thereby (see tables).

TABLE III—SURVIVALS BY CLINICAL STAGE—TOTAL 1926-1929—SECOND METHOD 72 TO 96 HOURS—3000 TO 5000 MG/M HOURS

Stage	Total	1	2	3	4	5	Per cent	Per cent	Operability	Died of Ca in 6th year	Symptom free after 5 years	Per cent
I	4	4	3	3	3	3	100	52.9		1	3	30
II	30	28	20	19	18	15	50			1	14	46.6
III	29	24	18	10	9	9	31			1	8	27.6
IV	13	2	0	0	0	0	0			0	0	0
Total	66	58	41	32	30	27	28.1		35.4	3	24	25

Note increase in Stage III survivals over 1921-1925 group. Also decrease in Stage II survivals.

TABLE IIIA—SURVIVALS BY CLINICAL STAGE—TOTAL 1929-1930—SECOND METHOD 144 TO 168 HOURS—6000 TO 10,000 MG/M HOURS

Stage	Total	1	2	3	4	5	Per cent	Per cent	Operability	Died of Ca in 6th year	Symptom free after 5 years	Per cent
I	6	6	6	6	6	6	100	6.8		1	5	83.3
II	22	20	15	13	13	13	59			0	13	59
III	33	27	18	15	11	9	27.2			0	9	27.2
IV	16	0	0	0	0	0	0			0	0	0
Total	77	53	39	32	30	28	36.3		36.3	1	27	35

Note increase in Stage I and II survivals. Stage III remains about the same.

## RESULTS

In reporting these results we have followed approximately the rules laid down by the League of Nations. In our *absolute survival rate* (we prefer not to use the word "cure"), we have taken the total number *seen* or *examined* as the denominator and the actual number alive at the end of 5 years as the numerator. This figure does not mean that all these patients are really free of disease. We do not know that, and we have had several patients whom we thought free of disease at the end of the fifth year develop disease and die in the sixth or seventh year. We have made, therefore, a separate column to show the number and percentage of those who survived the sixth year, and believe that we might assume that these were free of cancer at end of fifth year.

We have made charts to show results for the *whole 10 years* and for the *first 5 years* and for the *second 5 years*. We have again broken down the figures of the second 5 years to show the effect of increasing the time interval from 3 to 6 or 7 days, initiated in 1929.

Tables I, II, and III show the division according to the clinical stage when first treated, with corresponding 5 year survivals. Here again we have broken down our figures to show the changes in results between the first and last 5 years. We feel that the increase in survivals of Stage III cases from 6 of 43, or 14 per cent, in the first 5 years to 18 of 62, or 29 per cent, in the last 5

years is quite significant. The term operability used in the tables means the relation of the number of clinical Stage I and II cases to the total number.

It will be noted that there is apparently a large increase in the incidence of favorable cases in the last 5 years. This phenomenon is also noted in the reports of other clinics both in this country and abroad. One also notes that the increase in survivals in this series comes in the Stage III cases, the percentage of survivals in the favorable cases being about the same in the two groups.

*Effect of age on prognosis*—We have studied the effect of age on prognosis, dividing our cases into age groups by decades showing (1) the clinical stages occurring in each group, and so the operability or percentage of favorable cases, (2) the survivals and the survival rate. The youngest group, 20 to 29 years, is the smallest in number, 9 cases, has the greatest percentage of favorable cases, 66.6 per cent, and of the 5 year survivals, 55.5 per cent. The 30-39 age group comes next as to operability, 31.7 per cent, and survival rate, 31.7 per cent.

One would think from this study that "operability" had more to do with prognosis than age.

*Immediate mortality* We have since January, 1926, treated up to January, 1936, 373 cases of carcinoma of the cervix. In all of these cases with the exception of a few Stage I or II cases we have used the long platinum needles. If there is great

danger of severe infections with parametritis and peritonitis from this method we think that this fact should be reflected in our immediate mortality figures. We have had 11 deaths occurring from 3 days to 53 days after treatment in this series, which gives an uncorrected mortality of 2.9 per cent. Two of these patients are reported to have died of hemorrhage from the vagina, one had intraperitoneal treatment also and died on the eighth day after operation, and the other on the eighteenth day after operation. Two died of embolism—one on the third day after operation, the other on the ninth day. Both of these were Stage IV cases. One was a diabetic and a Stage IV and collapsed immediately after her anesthetic—probably cardiac. Two Stage IV patients died of peritonitis—one 8, the other 12 days after intraperitoneal implantation of needles. One died of toxic nephrosis 15 days after treatment. This was a Stage III case. Autopsy showed huge dilated kidneys with obstructed ureters—death was not due to the specific form of treatment but the patient had a chronic condition which would have resulted in disaster from any form of treatment we believe. Two patients died of sepsis 20 and 53 days after treatment and 1 patient died of intestinal obstruction 29 days after operation. If we deduct the cases in which death occurred after intraperitoneal application—2 of sepsis and 1 from hemorrhage from the vagina, which method we are perfectly willing to give up as of no value, our mortality from vaginal implantation of long needles becomes 2.1 per cent.

Such accidents as cerebral or pulmonary embolism occur with any type of treatment especially in advanced cases. We do not feel that our immediate mortality indicates that as a matter of practical use this method is dangerous. After all is said, cancer of the cervix is a desperate disease, and any method that can appreciably raise the percentage of 5 year survivals, even though it carries a slight increased danger, we believe is justified.

*Complications—fistulas—vesicovaginal and rectovaginal.* We have had 22 patients in this series develop fistulas, all of whom were treated cases. There were 17 vesicovaginal fistulas and 13 rectovaginal fistulas. 8 patients had both types. Of these patients 11 were treated in the 1921 to 1925 period and 11 in the 1926 to 1930 group. The vesicovaginal fistulas were 8 in the first group and 9 in the second. There were 7 rectovaginal fistulas in the first group and 6 in the second.

Two patients developed large bladder ulcers which after many months finally healed. These were late radiation effects.

From January 1931 to January 1, 1935, we have treated 170 additional cases. In this series not yet ready to report for final results, fistulas developed in 7 cases—2 cases in 1931, 2, in 1932, 3, in 1933, and none in 1934. Two of these patients had vesicovaginal fistulas, 2 rectovaginal, and three both types. Three of these were young women of Stage II type who in addition to the already large dose of radium had deep x ray treatment. We feel that the internal and external radiation were given too closely together.

Since 1932 we have been using deep x ray more or less routinely and have had some difficulty with rectal tenesmus and bleeding and non malignant ulceration and thickening. In the present series when external radiation was the exception we had little of this.

#### FOLLOW UP

In this series of 293 cases we have followed up all but 4 cases until death or for the 5 year period. This gives us a percentage of 98.6 per cent. One of these our youngest patient, who was 21 years old when first treated in 1922, moved to Ohio after 3 years of freedom from disease and we have been looking in vain for her since. Two others moved to New York City after 3 years and the other we cannot find any trace of after 3 years.

*Microscopic confirmation.* We have 54 cases of the 293 without microscopic confirmation. This fact might possibly be considered by some critics to weigh against the value of our report. An analysis of the type of case on which confirmation is lacking, however, shows that of the 54 cases 17 were hopelessly advanced so that no treatment was advised or carried out. All of these died of cancer within 1 year after being seen. Thirty were classed as Schmitz III, or IV, i.e. advanced beyond the confines of the cervix—none of whom survived the 5 year period. We do not think that there can be any question as to the diagnosis of cancer in these 47 cases. Of the 7 cases that survived the 5 years interval, 4 came in the first 120 cases from 1921 to 1925. Two of these were Stage II Schmitz 1 Stage III and 1 described as Stage IV. In the last 173 cases treated by the later method, only 3 survivors are without microscopic confirmation. Two of these are Stage II and 1 Stage III. That these cases were clinically malignant and had all the gross characteristics of cancer we are definitely certain. It is our definite intention to have biopsies on all but the hopeless cases. However accidents do happen to biopsy specimens—some are even lost and in the early years before our clinic was as well organized as it now is we were undoubtedly guilty of some carelessness in getting biopsies.

TABLE IV—COMPARISONS OF RESULTS IN CANCER OF THE CERVIX AT DIFFERENT CLINICS

Author and clinic	Total cases treated	Operability per cent	Living all cases treated		Period	Remarks
			Cases	Per cent		
Burnam 1931 (2)	262	20.6	60	22.9	1923-1927	
Healy 1928-31 (2)	374	28.0	97	25.9	1922-1924	
Schmitz (12)	607	21.0	133	22.16	1914-1929	Absolute figures
Mayo Clinic 1924 (2)	1242	not given	260	20.9	1910-1927	
Ward G G 1925 (13)	457	20.6	111	24.29	1910-1929	Absolute rate—treated
Heyman 1932-1934 (2)	1029	26.7	235	22.8	1910-1927	
Heyman 1931 (2)	270	32.5	54	20.0	1918-1930	Radium alone
Regaud 1932						External radiation
Lacassagne 1932 (2)	243	33.3	84	34.5	1924-1926	X-ray and radium
Regaud 1932 (2)	36	75.0	7	19.0	1921	
Lacassagne 1932 (2)	61	50.0	17	26.0	1922	Radium alone
Institut du Radium (2)	74	42.2	23	31.0	1923	
Volz 1912-31 (2)	720	44.0	173	24.0	1914-1928	
Marie Curie—London (2)	215	not given	72	33.4	1925-1928	Radium alone
Meigs	51	23.5	12	23.5	1925	
Noeris 1934	153	not given	35	22.8	1924-1926	
	205	20.0	20	26.0	1921-1930	Absolute figures
R I Hospital Fitts and Waterman 1936	120	19.1	23	20.0	1921-1925	Radium alone
	96	35.4	27	28.1	1926-1928	
	77	16.3	28	36.3	1929-1930	

when the clinical evidence was very convincing. We do feel, however, that a clinical diagnosis of cancer of the cervix can be very effectively made by men who are seeing such patients constantly.

**Comparison with other clinics** Comparisons of the work of one clinic with another are difficult. Certainly a comparison of anything but the absolute survival rates does not mean very much, and even then as some clinics have a much higher "operability rate" than others their results should be correspondingly better. One naturally expects to save more cases when one's "operability rate" is 35 to 50 per cent than when it runs between 15 to 25 per cent. We have arranged Table IV to show the published results of several clinics.

We feel, however, that our figures may be of true significance as pointing to the value of interstitial radiation of the parametria by the method of long needles, low intensity, heavy filtration, and long interval of time and single treatment, because of our own vastly improved results in Stage III cases. We have here parallel series all examined, classified, and treated by the same men under the same conditions. Therefore, it is probable that the Stage III classification is as near correct as possible for the two groups.

**External radiation—(x-ray)** We have not in these 293 cases used external radiation as a part of our primary treatment. Where it has been used it has been as a last resort after metastatic growths had developed in the parametria or iliac glands. The direction of the deep x-ray therapy has been under the department of x-ray of which Dr. James Boyd is the head. We have a machine capable of developing up to 200 kilovolts, 24 milliamperes. Of the 79 survivors, 14 had x-ray at some time during their treatment. Of these 5 died in the sixth year showing that the x-ray was used only to palliate.

Only 1 in the 1929 group had x-ray treatment, while 6 in the 1930 group had its benefit, 2 in the 1927 group and 2 in the 1926 group, none in the 1928 group.

**Surgery in survivors** One patient, 1922, had the uterine vessels tied because of hemorrhage. One patient, 1926, after 5 years had recurrence in the bladder. She had bilateral ureteral transplantation and total cystectomy. She is alive and well now 3 years after last operation. One patient, 1930, had hysterectomy later, because while removing appendix for cause, the uterus was examined and a small nodule on one side was seen. Total



hysterectomy was done, no cancer was present, but a small fibroid

*Relief of pain* Since 1933 we have done a number of pelvic and lumbar sympathetic neurectomies for the relief of intractable pain in advanced cases and have found the method a most valuable one

#### SUMMARY

1 A report is given of 293 cases of carcinoma of the cervix seen or examined at the clinic at the Rhode Island Hospital between 1921 and January 1931. Seventeen of these cases were too advanced to treat or refused treatment. 276 cases were actually treated.

2 The absolute survival rate, 1921-1930 was 79.29, or 26.9 per cent.

3 The absolute survival rate for the first 5 years under the older method was 24.120, or 20 per cent.

4 The absolute survival rate for the last 5 years under the newer method was 55.173, or 31.7 per cent.

5 The absolute survival rate from 1926-1928 when our time interval was 72-96 hours was 27.96, or 28.1 per cent.

6 The absolute survival rate from 1929-1930 when the time interval was increased to 144-168 hours was 28.77, or 36.3 per cent.

7 The absolute survival rate of Stage III cases 1921-1925 under the older method was 6.43, or 14 per cent, with only 3.43 surviving 6 years, or 6.9 per cent.

8 The absolute survival rate for Stage III cases 1926-1930 under the newer method was 18.62, or 29 per cent, with 17.62, or 27.4 per cent, alive 6 years.

9 The uncorrected immediate mortality for this group is 2.9 per cent (1926-1930).

10 The incidence of fistula under the older method 1921-1925 was 11.120, or 9.1 per cent. The incidence of fistula under the newer method 1926-1930 was 11.173, or 6.3 per cent.

11 In this series the youngest age group had the highest survival rate 5.9, or 55.5 per cent, also had the highest number of early cases 6.9, or 66.6 per cent. The greatest number of cases came between 40 to 60 years, the salvage for the fifth and sixth decades being 31.7 per cent and 26.9 per cent, respectively.

#### CONCLUSIONS

We believe that these figures show that interstitial radiation according to our technique, i.e., low intensity long needles with 0.5 millimeters platinum filtration well distributed out in the paracervical and parametrial tissues, has a distinct value in the treatment of cervical cancer especially of the Stage III (Schmitz) group, and that these results have been obtained without undue immediate mortality or without increasing the incidence of fistula formation.

The authors wish to express their appreciation to Dr. Eric Stone of Providence for his excellent drawings.

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# CARDIAC ASTHMA AND ACUTE PULMONARY EDEMA

## Complications of Non-Convulsive Toxemia of Pregnancy<sup>1</sup>

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ACUTE pulmonary edema is a frequent and distressing complication of eclampsia. It occurs in approximately 30 per cent of all cases, and its incidence is considerably higher in those which terminate fatally. Study of the reported cases of "eclampsia without convulsions" reveals that in them acute pulmonary edema is even more frequent than in typical eclampsia. Thus, in the cases of "eclampsia without convulsions" reported by Slemons, acute pulmonary edema was found in 6 patients of 7 coming to autopsy. It is perhaps also of interest that in the reported case histories of "eclampsia without convulsions," dyspnea has been frequently observed.

Consideration of these facts immediately raises the interesting question as to the cause of acute pulmonary edema in eclampsia. The observation that it often develops late in the course of fatal cases suggests that it may be simply a consequence of terminal failure of the pulmonary circulation. However, not all eclamptic patients die even though marked pulmonary edema develops. Since the development of acute pulmonary edema is not always agonal in eclampsia, inquiry into its cause might reasonably lead to an understanding of the mechanism involved, as well as to rational measures for its prevention and management.

We have observed the occasional occurrence in the course of severe non-convulsive toxemia of a dramatic and dangerous syndrome which we shall call "cardiac asthma." In these unusual cases the toxemic patient, while at bed rest, often without previous dyspnea or signs of embarrassment of the pulmonary circulation, is seized with a severe paroxysm of dyspnea associated with extreme orthopnea, cyanosis, and acute pulmonary edema. The

behavior of these non-convulsive toxemic patients suggests an explanation for the development of acute pulmonary edema in eclampsia as well.

No one seems to have studied and followed a series of such patients, and little is known about them. However, in the paper of Schmorl discussing eclampsia without convulsions the first case reported seems to have been similar to the cases which we shall present. A possible second case has been reported by Adair and Stieglitz. This case is the only one in which hydrothorax was encountered such as occurred in our patient examined postmortem. Dr. Burton E. Hamilton, the cardiac consultant to the Boston Lying-in Hospital, who saw all of the patients to be presented in this paper, had a similar patient, aged 22, who died but upon whom no autopsy was performed.

When cardiac asthma and acute pulmonary edema have occurred during the course of non-convulsive toxemia in this clinic, the suspicion has arisen in our minds that hypertension, coronary disease, or nephritis may have been present before the onset of pregnancy. This has been particularly true of a number of emergency patients in whom past histories and knowledge of the blood pressure and urine findings in the early months of pregnancy were lacking.

The case histories of 6 toxemic patients who developed this syndrome are presented.<sup>2</sup> None of them had valvular heart disease. There

<sup>1</sup>These 6 cases have occurred during the past 3 years at the Boston Lying-in Hospital. During the same period there have been 60 cases of eclampsia in this institution. Thus the incidence of cardiac asthma as a complication of non-convulsive toxemia has been one tenth that of eclampsia. If one were to include a number of equinoctial cases and the fairly common instances in which one obtains a history of attacks suggesting paroxysmal dyspnea in toxemic patients this latter complication of non-convulsive toxemia would be much more common.

We have not included a number of cases of paroxysmal dyspnea which occurred in patients with non-convulsive toxemia known to have been complicated by pre-existing cardiac or vascular disease. The initial attack of cardiac asthma in some of these cases occurred during the course of the pregnancy toxemia.

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were known past histories and prolonged subsequent observation in some, and an autopsy was obtained in one instance. Study of these cases seems to us to indicate that in at least 4 of them previous hypertension, coronary disease, and nephritis were not involved, that this symptom complex which we have called cardiac asthma and acute pulmonary edema may complicate simple acute pre-eclampsia.

**CASE 1.** A Mc, an Irish woman of 45 registered in the prenatal clinic in the twenty-fourth week of her sixth pregnancy. The past history revealed excellent health. There was no history of rheumatic fever or chorea, and there had been no symptoms referable to heart disease. The blood pressure had not been taken in the non-pregnant state. There were 4 living children all born at term and 1 miscarriage of unknown cause at 4 months. There has been no toxemia with any of the previous pregnancies; the last of which was 6 years ago.

The present pregnancy progressed normally with out symptoms, edema, hypertension or albuminuria until the thirty-first week, when the blood pressure was found to be 144 systolic, 88 diastolic in the clinic. After a few minutes rest it was checked at 126 systolic, 78 diastolic. As there was neither edema nor albuminuria and the patient was without symptoms except for slight dyspnea, she was instructed to return in 2 weeks. She failed to return until the thirty-fourth week, at which time she gave a history of vertigo, blurred vision, irritability and progressively increasing edema, all of about 10 days duration.

Physical examination on admission revealed massive edema, normal heart and lungs, blood pressure 180 systolic and ++++ albumin in the urine. The ocular fundi showed no edema, hemorrhages, exudate or retinal vessel sclerosis. The urine concentrated to 1.028, the blood non-protein nitrogen and uric acid were 37 and 3.6 milligrams per cent, respectively. The patient was treated by bed rest, cathartics, restricted fluids and light diet. She remained comfortable and lost considerable edema on this regimen. The albumin diminished to + on the fifth day, although the blood pressure remained in the region of 160 systolic, 110 diastolic. At 5:00 o'clock on the morning of the sixth day, after a comfortable night, there were sudden extreme orthopnea and dyspnea. The respirations became wheezing in character and pink frothy fluid exuded from the mouth and nose. The patient was extremely cyanotic, the pulse was rapid and feeble and the lungs were filled with bubbling rales. She was seen by the cardiologist who made a diagnosis of definite cardiac asthma. Morphine was administered in large doses and the patient became somewhat more comfortable after about 45 minutes, although dyspnea and orthopnea continued and numerous rales were still present. She was rapidly digitalized and 42 hours after the initial attack of paroxysmal dyspnea

although compensation had not been re-established a cesarean section was done. Her condition was critical during the operation, although no worse than before. The patient held her own for 36 hours after the operation when there was another severe bout of paroxysmal dyspnea. Her condition at this time seemed almost hopeless. She was placed in an oxygen tent for 48 hours. The blood at this time showed 8,700,000 red cells, checked at 7,450,000 and a hemoglobin of 93 per cent, evidence of the marked blood concentration. From the third day on the patient improved steadily from the cardiac standpoint. The blood pressure returned to 130 systolic, 86 diastolic in 2 weeks and shortly before discharge of the patient on the thirty-second post-operative day it was 110 systolic, 76 diastolic. Two months after discharge there were no cardiac symptoms and a 7-foot heart plate showed no cardiac enlargement. Four months after discharge the urine was free of albumin and the blood pressure was 130 systolic, 80 diastolic. This patient was last seen more than 2 years after this episode, at the age of 47. She had been doing all the housework, including washing for a large family, since her return home, and there were no cardiac symptoms. The urine was free of albumin, the blood pressure was 134 systolic, 90 diastolic. Physical examination showed no edema, the lungs clear, the heart not enlarged, rate 84, rhythm normal and sounds normal except for a moderate apical systolic murmur.

At the time of its occurrence, we thought that this patient's toxemia was superimposed upon a pre-existing hypertension. However, the blood pressure had been normal earlier in pregnancy, the retinal vessels were normal, and a 7-foot x-ray plate of the heart showed no enlargement. After 2 years she still has a normal blood pressure, normal urine, and no symptoms or signs of heart disease.

Therefore, it seems reasonable to interpret the cardiac asthma and acute pulmonary edema as complications of a simple acute pre-eclampsia without preceding nephritis, hypertension, or organic heart disease.

**CASE 2.** N. M., aged 26 years, was referred to the clinic by her physician in the thirty-seventh week of her fourth pregnancy because of increasing edema, hypertension and albuminuria.

The past history revealed excellent health and nothing to suggest heart disease or nephritis. At an insurance examination 3 years before admission the urine and blood pressure were said to have been normal. The three previous pregnancies were without symptoms of toxemia and all babies survived. The last pregnancy was 3 years before the present one.

The present pregnancy was entirely uneventful until the thirty-fourth week when the patient first

noticed edema of the feet. This increased steadily, later involving the hands and face. *During the week before admission she had repeatedly awakened from sleep with a suffocating, smothering sensation.* It was this latter complaint which caused her to consult her physician, whence she was referred to this clinic. There had been no headache, visual disturbance, vomiting, or epigastric pain.

Physical examination on admission revealed marked generalized edema, and hyperactive reflexes. The heart and lungs were normal. The pulse was 100, and the blood pressure 180 systolic, 120 diastolic. The urine showed a specific gravity of 1.035, +++++ albumin and granular and cellular casts. The blood non protein nitrogen and uric acid were respectively 35 and 5.7 milligrams per cent. Examination of the ocular fundi revealed no sclerosis of the retinal vessels, hemorrhages or exudate. The findings were obviously those of relatively severe pre-eclampsia, and the patient was treated accordingly. She was placed at bed rest, and given morphia and chloral, as well as magnesium sulphate intravenously. As there was slight clinical improvement after 24 hours the patient was placed on a regimen of free catharsis, light diet, and restricted fluids. During the next 6 days the urine output ranged from 26 to 70 ounces daily, and the edema decreased considerably. However, the blood pressure remained in the region of 170 systolic, 110 diastolic, and the urine continued to show +++++ albumin. On the tenth day in the hospital, after having been at complete bed rest, the patient suddenly and without the slightest warning had a severe attack of cardiac asthma. There were marked orthopnea, dyspnea, cyanosis, and wheezing asthmatic respirations. A few hours after the acute attack she was examined by the consulting cardiologist. The essential findings were marked fluctuation in the heart rate, a loud systolic murmur, extrasystoles, and definite puls alternans. A diagnosis of acute heart failure and paroxysmal dyspnea was made. Because of her critical condition, the patient was delivered the same evening by cesarean section under local anesthesia. The baby, which weighed 5 pounds 2 ounces survived, and the patient improved rapidly following delivery. She was discharged with compensation fully re-established on the eighteenth postpartum day, at which time the blood pressure was 104 systolic, 70 diastolic, and the urine free of albumin.

*Eight years following the above episode* the patient returned for care in a subsequent pregnancy. The prenatal course was complicated by a bleeding gastric ulcer, but there were neither cardiac nor toxemic symptoms. She was delivered normally, at term of a live 9 pound 6 ounce baby, and was discharged 2 weeks postpartum. The maximum blood pressure during the whole pregnancy was 130 systolic, 86 diastolic, and the urine showed no albumin. The patient was last seen 3 months after delivery of her last baby, more than 8 years after the occurrence of cardiac asthma during the course of pre-eclampsia.

Physical examination at this time revealed no

cardiac enlargement or heart murmur, and normal rate and rhythm. Cardiac measurements on the 7 foot x ray plate were normal. The blood pressure was 124 systolic, 84 diastolic, and the urine showed no albumin. She had never had recurrence of paroxysmal dyspnea, or cardiac embarrassment, in spite of doing all the housework for a family of six.

In retrospect we would interpret this patient as one in whom uncomplicated but increasingly severe pre-eclampsia resulted in severe cardiac asthma. Her rapid recovery and her condition 8 years after the toxemic pregnancy complicated by cardiac asthma excludes organic heart disease, essential hypertension, and chronic nephritis as contributory causes of this complication.

CASE 3. S. Y., a tertipara, aged 32 years, was referred to the hospital by her physician in the thirty-eighth week of pregnancy for the treatment of toxemia.

The past history revealed scarlet fever and rheumatic fever in childhood. In addition, the patient had been troubled with a varying amount of edema of the legs, arms, and face since earliest childhood. The general health had been good and there had been no cardiac sequelae to the rheumatic fever. Both previous pregnancies had been complicated by toxemia, both babies had survived, the youngest being 3 years old.

The present pregnancy had progressed without hypertension, albuminuria, or symptoms, except for slight edema, until 10 days before admission. The blood pressure was recorded by her physician as 120 systolic in the seventh month, and again as 130 systolic in the thirty-sixth week. During the 10 days before admission there had been increasing edema of the hands, feet and face, headache, drowsiness, and visual disturbance.

Physical examination on admission revealed nothing of significance other than marked edema. The heart and lungs were normal. The blood pressure was 160 systolic, 110 diastolic, and the urine showed +++++ albumin and numerous hyaline and granular casts. The blood non protein nitrogen and uric acid were 34 and 6.9 milligrams per cent, respectively. Examination of the ocular fundi revealed no sclerosis, hemorrhage, or exudate. The day following admission the blood pressure rose to 200 systolic, and as the patient was a multipara near term labor was induced by rupture of the membranes. A live baby weighing 6 pounds 12 ounces was delivered normally 6 hours later. As the blood pressure remained in the region of 190 systolic, 130 diastolic, and the toxemic symptoms persisted following delivery, the patient was given liberal doses of morphia for 3 days. On the third day a plasmapheresis was done. Her condition seemed to improve on the fourth day, although the blood pressure remained high. On the fifth postpartum

day the patient suddenly became dyspneic orthopneic and cyanotic the pulse became weak and thready and the lungs filled with râles. There was no pain, and there were neither signs nor symptoms to suggest pulmonary embolus. She was seen after the acute episode by the cardiologist who made a diagnosis of congestive heart failure. Her condition was desperate and it was felt that she would not recover. However on digitalis and morphia the râles gradually disappeared and the cardiac condition steadily improved. The patient was discharged on the twenty seventh postpartum day fully compensated with a blood pressure of 100 systolic 80 diastolic and urine free of albumin. Three months later the blood pressure and urine were normal but there was moderate ankle edema. However there were no heart symptoms.

The patient reported 18 months later in the third month of pregnancy. She was admitted to the hospital for study and decision as to therapeutic abortion. At this time the physical examination was entirely negative except for marked edema of the ankles. The blood pressure was 120 systolic 70 diastolic the urine was free of albumin the blood non-protein nitrogen was 25 milligram per cent and the uric acid 2.6 milligram per cent. The phthalein test revealed 80 per cent excretion of the dye in 2 hours and 10 minutes. In spite of these normal findings it was thought that therapeutic abortion was indicated on the basis of the persistent edema and the past history of severe toxemia which had occurred in three successive pregnancies complicated by cardiac decompensation in the last one. Accordingly an abdominal hysterectomy was done and the patient made an uneventful convalescence.

*This patient has last seen 6 years after the episode of cardiac asthma and acute pulmonary edema complicating toxemia.* The blood pressure was 118 systolic 78 diastolic and the urine normal. There was still fairly marked edema of the lower legs. Examination of the heart revealed no pathology and a 7 foot x ray plate showed the cardiac measurements to be normal. At this last visit the patient stated that she had been in excellent health except for the discomfort of a variable amount of edema. Careful anamnesis at this time revealed that the patient's mother and two of her sisters also have had similar edema since early childhood. The sisters are in good health as is the mother at the age of 70 although she still has edema. Thus it appears more than likely that this patient's edema is of the familial type described by Milroy and independent of either cardiac or renal disease.

Whether Milroy's disease predisposes a patient to toxemia we do not know but this case would appear to be another one of acute pre-eclampsia complicated by cardiac asthma and acute pulmonary edema. It is the only case in which the syndrome occurred postpartum. It is perhaps significant that large amounts of

edema fluid were in transit, as evidenced by marked diuresis preceding the attack. The Milroy's disease may have been a predisposing factor in the development of pulmonary edema. There is no evidence to justify a diagnosis of preceding heart disease, hypertension, or nephritis.

**CASE 4.** E. C. an Italian octipara of 38 registered in the clinic in the seventh month of pregnancy with complaints of cough and edema.

The past history was negative. She had been delivered by our service of her last three babies at home. The deliveries were normal and there was no toxemia with any of them. The last baby was delivered less than 2 years before the present pregnancy. The patient had reported twice to the clinic following the last pregnancy. At both visits the blood pressure was normal and the urine contained no albumin.

The present pregnancy had been uneventful until about 10 days before admission when the patient thought that she had acquired a cold and began to cough. The cough had increased in severity and became productive although she had never spat up blood. In addition she had noticed an increasing amount of swelling of the lower extremities. As the patient was obviously acutely ill she was immediately admitted to the hospital.

Physical examination on admission revealed a white female who weighed 137 pounds sitting upright in bed with massive edema, some dyspnea and cyanosis. The pulse was 130 the temperature 100 the respirations 30 and the blood pressure 180 systolic 140 diastolic. The heart showed a rapid rate and a soft systolic murmur at the base. There was no demonstrable enlargement. Examination of the lungs revealed crepitant râles throughout. The abdomen was negative except for the uterus which was consistent in size with a 7½ months pregnancy. The extremities showed marked edema particularly below the knees and slight varicosities. Examination of the ocular fundi revealed normal optic discs with no retinal vessel sclerosis no retinal hemorrhages and no exudate. The admission catheter urine specimen showed ++ albumin no sugar and negative sediment. The blood non-protein nitrogen and uric acid were 27 and 3 milligrams per cent respectively.

The patient was placed at bed rest. During the night the urinary output was 34 ounces the concentration of which reached 1.026. She slept fairly well and appeared considerably improved the following morning 12 hours after admission. The blood pressure at this time was 170 systolic 100 diastolic the temperature 98.9 the pulse 118 and the respirations

4. A few minutes after these observations the patient suddenly cried out, sat up in bed, held both of her hands against her chest and then sank back on the pillow.



Fig 1 Heart showing edema of myocardial stroma  $\times 150$



Fig 2 Heart showing edema and leucocytic infiltration of myocardial stroma  $\times 300$

She became very cyanotic, and dyspneic, and a large amount of frothy fluid began to exude from the mouth. The respirations ceased about 5 minutes after the onset of the attack, and the heart stopped beating shortly thereafter. There was nothing about this seizure of dyspnea and orthopnea suggestive of a convulsion.

The following is a résumé of the autopsy protocol<sup>1</sup> of this patient, and includes the positive findings together with significant negative observations.

At postmortem, performed 4½ hours after death, there was revealed the body of a well developed and nourished white female 152 centimeters in length. An abundance of clear frothy, blood free fluid was present in the nose and mouth. Moderate pitting edema of the legs was noted, more marked on the right. The slightest possible trace of thin, clear fluid was found in the peritoneal cavity, probably associated with the presence of a normal 7½ months' pregnant uterus.

Each pleural cavity contained 300 to 400 cubic centimeters of thin clear, colorless liquid. Their

serosal surfaces were smooth, glistening, and without exudate or adhesions. The lungs completely filled the thoracic cage, and bulged into the autopsy incision.

The pericardial sac contained a moderate excess of thin, clear, colorless liquid estimated at 60 cubic centimeters. The heart, which was not enlarged for a woman of this age and height (37 years and 152 cm respectively), had stopped in systole. No emboli were found in any of the pulmonary vessels or their branches.

The heart weighed 335 grams. None of the valves showed stenosis or insufficiency. The mitral leaflets and their chorda tendinae were slightly thickened, but vegetations were absent. Mural thrombi were absent from all portions of the endocardium. The myocardium was reddish brown and firm throughout, showing no gross areas of fibrosis or softening. The coronary arteries arose in the usual manner, and upon careful dissection revealed no atheroma, thrombi, or emboli. Microscopically the significant findings in the myocardium were marked edema of the stroma (Fig 1) and occasional moderate size areas of polymorphonuclear and mononuclear leucocytic infiltration of the edematous stroma (Fig 2). No Aschoff bodies were found. No necrosis or fatty degeneration of the myocardium was encountered. There was, however, slight atrophy of

<sup>1</sup> We are indebted to Professor S. Burt Wolbach of the Department of Pathology for his help in studying and interpreting the pathological findings in this case.

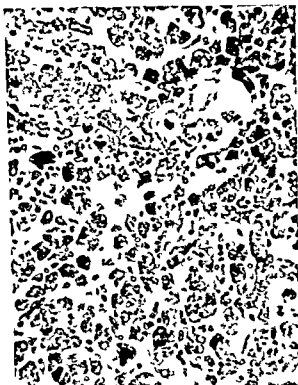


Fig 3 Liver showing fragmentation of columns but without necrosis of cells  $\times 300$

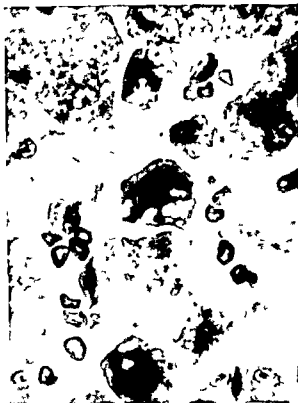


Fig 4 Liver cells containing bird's-eye bodies  $\times 1000$

occasional muscle fibers associated with slight sub-endocardial fibrosis. The branches of the coronary arteries showed no thrombosis or embolism. Connective tissue stains showed occasional instances of slight thickening of the internal elastic membrane of the smaller coronary branches. One small branch also showed slight intimal proliferation.

The lungs together weighed 1335 grams and were the seat of moderate congestion and marked edema. Large amounts of thin, clear, slightly frothy fluid poured from the bronchi and from the cut surfaces. Microscopically, in addition to the congestion and free edema, there was marked interstitial edema of pulmonary stroma. This was most noticeable around the bronchi, bronchioles, and medium-sized vessels. Slight emphysema of alveolar ducts was encountered. No significant bronchopneumonia was present, although rare lobules of alveoli contained a few polymorphonuclear leucocytes and small amounts of fibrin.

The spleen weighed 260 grams and was slightly soft in consistency. Stab cultures revealed no bacterial growth at 72 hours. Recent hemorrhages up to 4 millimeters occurred throughout the red pulp. The usual markings were obliterated from the cut surface. Microscopically, no evidence of an acute splenitis was found. Congestion was absent but the presence of hemorrhages mentioned was confirmed.

The liver weighed 1590 grams and was grossly negative except for occasional minute recent hemorrhages beneath the capsule. The cut surfaces revealed numerous small recent hemorrhages—apparently in the periportal region of the lobule. Microscopically, the periportal region of the lobule gave evidence of early degenerative changes. The cell columns were fragmented (Fig 3) and the cytoplasm of their cells contained numerous so-called bird's-eye bodies. These structures appear as a vacuole containing a pink-staining hyaline droplet (Fig 4). The nuclei of these affected cells were apparently normal. Rarely, however, a focus of true necrosis was encountered in the periportal region of the lobule. The small recent hemorrhages were periportal or midzonal in distribution. A slight amount of fat was found in the central portion of occasional lobules. There was no generalized acute passive congestion, although the sinusoids of occasional lobules were distended by red cells.

The right and left kidneys weighed 200 and 220 grams, respectively. They were normal in size, shape, and consistency. The capsule was thin and stripped with moderate ease. The pelvic fat was normal in amount and character, although the perirenal fat was slightly edematous. The gross impression was that of normal kidneys. Microscopically, the glomeruli showed slight ischemia but no essential thickening.

ing of the basement membrane such as Bell described in the kidneys of fatal cases of eclampsia and pre eclampsia. Fibrin thrombi were found rarely in the glomerular capillaries (Fig 5). Fatty degeneration and necrosis of glomerular epithelium and endothelium were occasionally noted, sometimes associated with fibrin thrombi in the glomerular capillaries but more often not. Often a moderate number of polymorphonuclear leucocytes were found infiltrating the glomerular tuft. The epithelium of Bowman's capsule occasionally was the seat of hyaline degeneration. No hemorrhage into the capsular space was noted. Fatty and hyaline degeneration of the proximal and distal convoluted tubules were occasionally encountered (Fig 5). All convoluted tubules contained granular precipitate and oftentimes desquamated epithelial cells, but no casts, red or white blood cells. The stroma was moderately edematous. The vessels of the medulla were engorged while those of the cortex were moderately congested. The small arteries and arterioles showed no sclerosis. In summary, the kidneys showed an early acute toxic glomerular and tubular nephritis, but without evidence of nephrosclerosis or true glomerular nephritis.

The brain, both grossly and microscopically, showed moderate congestion and edema.

The aorta, both grossly and microscopically, showed slight atheroma, but was otherwise negative.

The gross and microscopic findings in this case are interpreted as indicating that the patient was suffering from a true acute toxemia of pregnancy. The pathological lesions in the liver, kidney, and brain differ in no way from those found in fatal cases of eclampsia except in their degree of development, in this case they are in the process of forming, where as in eclampsia they are usually more marked. It is further concluded that the most logical interpretation of the findings in the heart and lungs is one of acute left ventricular failure, resulting in marked pulmonary congestion and edema with slight emphysema. The slight amount of subendocardial fibrosis of the myocardium and of the mitral leaflets together with the heart weight do not warrant a diagnosis of chronic heart disease. The edema and leucocytic infiltration of the myocardial stroma, however, are consistent with an acute process the cause of which is not clear. That an acute process is present which could interfere with cardiac function cannot be denied. A bacterial etiological agent can presumably be excluded, since organisms could not be demonstrated in the myocardium, and none could be grown from the spleen culture.



Fig 5. Kidney showing thrombosis of glomerular tuft and hyaline degeneration of proximal convoluted tubules  $\times 300$ .

CASE 5. M. C., a quadripara of 39 years was admitted to the hospital in the seventh month of pregnancy because of hypertension, albuminuria, edema, dyspnea, and orthopnea.

The past medical and obstetrical history was essentially negative except for increasing obesity over a period of 18 years. There had been no symptoms referable to hypertension or heart disease. The blood pressure and urine had been repeatedly normal at biannual examinations during the past 6 years. The three previous pregnancies had ended in normal deliveries at term. The first and third pregnancies were without incident. The second was complicated by mild toxemia in the last 2 weeks. There was no subsequent hypertension or albuminuria. The last pregnancy was 9 years ago.

The present pregnancy progressed uneventfully until 1 month before admission when the patient first noticed edema, dyspnea, and orthopnea. As her symptoms became progressively worse, she consulted her physician, who found hypertension and albuminuria, and referred her immediately to this clinic.

Physical examination on admission revealed a large, obese, dyspneic woman who weighed 301 pounds. The respirations were rapid; the pulse 90 to 118, and the blood pressure 186 systolic, 126 diastolic. There was massive generalized edema most marked over the lower extremities and abdomen.



The lips and fingers were slightly cyanotic but the neck veins were not distended. The heart appeared slightly enlarged but the rhythm was normal and there were no murmurs. There were a few sibilant rales in both midscapular regions and at the left base but no crepitant rales were present at this examination. The abdomen was pendulous and edematous. The size of the uterus could not be accurately estimated. The ocular fundi showed slight retinal vessel sclerosis.

The urine which concentrated to 1.030 contained + + + + albumin with an occasional red blood corpuscle and granular and hyaline casts. Examination of the blood showed 4,150,000 red blood corpuscles 65 per cent (Sahli) hemoglobin non protein nitrogen 31 milligrams per cent and uric acid 3.6 milligrams per cent. The serum proteins were 5.01 grams (albumin 2.51 globulin 2.07 and fibrinogen 0.43 grams). The urea clearance was 145 per cent.

Under a regimen of bed rest, restricted fluids, catharsis, saline diuretics, morphine for comfort and slow digitalization the patient lost 20 pounds in the first 48 hours. However her clinical condition remained unaltered. During the afternoon of the third day she suddenly awakened from a nap with a severe attack of cardiac asthma. The attack which lasted from 15 to 20 minutes was characterized by extreme respiratory distress, particularly of expiration, orthopnea, cyanosis. The skin became cold and clammy, frothy fluid exuded from the mouth and bubbling rales appeared throughout the chest. During the attack the blood pressure fell from *circa* 200 systolic 120 diastolic to 150 systolic 120 diastolic. Following the attack the patient was apathetic and at times semistuporous. Rales persisted at the lung bases and her critical condition made it appear that immediate interference with her pregnancy would result fatally. She was treated expectantly with the hope that she would improve. However she failed to improve; the pulse and blood pressure rose, the albumin persisted and the blood non protein nitrogen rose to 43 milligrams per cent. Eight days after the attack of cardiac asthma labor was induced by the insertion of bougies. She reacted poorly to the manipulation; the blood pressure fell to 70 systolic 44 diastolic and the respiration became labored. Twelve hours later a stillborn infant 19 inches long which weighed 4 pounds 12 ounces was born spontaneously. Following delivery the patient began to improve. The edema regressed rapidly, the blood pressure gradually became lower and the albumin diminished in the urine.

The patient was discharged home 3 weeks after delivery, very weak but with compensated circulation. The blood pressure at the time of discharge was 130 systolic 96 diastolic; the urine contained albumin and the patient had lost 73 pounds. An x-ray plate of the heart before discharge showed slight enlargement and repeated electrocardiograms the first of which was taken 4 days after the attack of cardiac asthma showed no conclusive evidence of organic heart disease.

The patient slowly regained strength for 3 weeks after discharge when she developed slight fever, chills and faintness for which she was admitted to a general hospital. Physical examination from their records was reported essentially negative except for slight right costovertebral tenderness. The heart was reported not enlarged. The urine which concentrated to 1.030 showed + to + + albumin 6 to 12 white blood corpuscles and rare hyaline casts. She was discharged after 10 days without a definite diagnosis. The impression was that the patient had a subsiding glomerular nephritis.

The patient was re-admitted to this hospital for follow up study 5 months after delivery. Since her discharge she had lost 10 pounds. Physical examination except for moderate weakness and obesity, was essentially negative. The ocular fundi again showed slight retinal vessel sclerosis. The blood pressure was 120 systolic 80 diastolic. The urine concentrated to 1.032 and showed from 0 to + + albumin 25 to 30 white blood corpuscles and no red blood corpuscles or casts. There was no anemia; the blood non protein nitrogen was normal and the urea clearance was 85 per cent. Electrocardiogram and x-ray plate of the heart showed no significant change from previous examination. The patient was discharged to a convalescent home.

Seven months following delivery this patient is still weak and is dyspneic on moderate exertion. She has been on a rigid diet and now weighs 109 pounds. There have been two recent brief attacks of precordial pain, one of which was associated with slight cyanosis and dyspnea but no cough. The urine is negative for albumin and the blood pressure is normal.

That this patient suffered from an acute and severe toxemia of pregnancy is clear. Further she developed severe cardiac asthma with acute pulmonary edema and heart failure as a complication of her toxemia. To what extent antecedent chronic vascular disease may have contributed to this complication is uncertain. On the one hand, at frequent examination during a 6 year period prior to pregnancy the blood pressure and urine were reported normal. Further there had been no subjective evidence of heart disease in spite of a vigorous farm life prior to the development of her toxemia. On the other hand, the patient was 39 years old, had a long history of obesity and there was slight but definite sclerosis of the retinal vessels. The protracted and incomplete recovery of the patient after 7 months may be due in part to the prolonged severe toxemia and her marked obesity, although coronary disease cannot be excluded.

TABLE I—SUMMARY OF CLINICAL AND LABORATORY FINDINGS IN FIVE PRE ECLAMPTIC PATIENTS WHO DEVELOPED CARDIAC ASTHMA AND ACUTE PULMONARY EDEMA

Age Panty	Name	Symptoms	Blood pressure	Urine albumin	Urine sediment	Maximum sp gr	Edema	Cardiac asthma	Pulmonary edema	Non protein nitrogen	Uric acid	Extravascular	Baby	Onset of pre-eclampsia	Onset of cardiac asthma and pulmonary edema	Blood pressure and albumin 3 weeks post partum	Follow up later
A Mc 45 VI		Blurred vision, irritability, vertigo	160 110 180 110	L T	Cast	1.025	3+	+	+	37 36	3.6 3.5	Negative	4 lbs 6 oz died in 3 hrs	31 wks	35 wks	110 80 Albumin ?	After 2 yrs B.P. 120/90 Albumin o Well
N M 26 IV		Headache, vomiting	180 120 100 150	L T	Cast	1.035	4+	+	+	35 27 35	5.3 5.7 5.6	Negative	5 lbs 2 oz lived	34 wks	38 wks	130 84 Albumin o	After 8 yrs B.P. 120/84 Albumin o Well
S V 32 III		Headache, drowsy, visual disturbance	150 110 200 130	L T	Hyaline and granular casts	1.040	4+	+	+	34	6.9	Negative	6 lbs 12 oz lived	36 wks	38 wks	120 78 Albumin o	After 6 yrs B.P. 118/78 Albumin o Well
E C 33 VIII		Dyspnea, cough	180 140 170 100	S T	Negative	1.026	4+	+	+	27	3.0	Negative	Died, undeveloped	33 wks	35 wks	Died	Died autopsy
M C 39 III		Dyspnea, orthopnea	100 118 200 140	L T	Granular casts	1.037	4+	+	+	31 41 46	3.6 5.7 4.3	Slight sclerosis	4 lbs 12 oz still born	29 wks	34 wks	160 102 Albumin trace	After 7 mon B.P. 110/80 Albumin o specific gravity 1.032 Improved

The 5 patients whose histories have been presented all developed severe toxemia during the last trimester of pregnancy, and none of them had convulsions or coma (eclampsia). The important clinical and laboratory findings upon which this statement is based are summarized in Table I. We believe they all suffered from simple pre-eclampsia, without pre-existing hypertension or nephritis. In one instance the autopsy findings substantiate this opinion. In the 4 others clinical histories and follow-up studies lend support to this position.

In all 5 cases the pre-eclampsia was complicated by the dramatic occurrence of what we have called cardiac asthma and acute pulmonary edema. In each case the latter had its onset with a paroxysm of dyspnea which occurred suddenly while the patient was at bed rest under treatment.

It would seem logical to expect cardiac asthma as a complication of pregnancy toxemias which were superimposed upon pre-

existing hypertension or nephritis. Such cases do occur, and chronic nephritis or hypertension may have been a complicating factor in the following fatal case.

CASE 6 D H, a primipara of 31 years, was referred to the hospital by her physician, in the seventh month of pregnancy, because of hypertension and albuminuria. Nothing was learned of her past history except that there was no rheumatic fever. The duration of the hypertension and albuminuria were unknown.

On admission the blood pressure was 210 systolic, 130 diastolic, and the urine showed ++++ albumin with numerous granular casts. About 1½ hours after her admission, while at bed rest, the patient was found in a severe attack of acute pulmonary edema with dyspnea, orthopnea, and cyanosis, and the lungs filled with râles. On morphine, atropine, and a venesection she improved for a few hours but developed a subsequent attack, and died undelivered, 14 hours after admission, in spite of a second venesection. No autopsy was obtained.

The cardiologist could find no evidence of a valve lesion in this patient. Due to lack of history and opportunity to study her, it was

impossible to determine whether chronic vascular or renal disease complicated the acute toxemic state. What we do know is that this primipara of 31 had severe toxemia during the last trimester of pregnancy, and that she died after two severe attacks of acute pulmonary edema.

That a syndrome strikingly similar to, and possibly identical with classical cardiac asthma may complicate the course of pre-eclampsia in a patient previously and subsequently free of cardiac renal and vascular disease would seem to be of interest both to obstetrician and internist.

The 6 patients presented all had severe toxemia of pregnancy with marked hypertension, albuminuria and edema. They all had one or more sudden and severe paroxysms of dyspnea which came on while at bed rest. In three instances the attacks awakened the patient from sleep. Clinical signs of acute pulmonary edema were present during and following the attacks and the lungs of the patient upon whom an autopsy was performed showed marked pulmonary edema.

While it is not our purpose to review the general subject of cardiac asthma, a brief resume of some of the principle changes concerned in this condition according to current viewpoints is not afield. The precise physiological and pathological disturbances which lead up to and precipitate these attacks are as yet incompletely understood. However clinical observations and physiological studies have brought to light a number of changes which may be significant in their etiology. Several of these factors are briefly presented.

1. The vast majority of patients subject to attacks of cardiac asthma suffer from conditions which impose a burden on the left ventricle such as primary hypertension, chronic nephritis, coronary sclerosis or aortic insufficiency. The trend of present medical opinion would associate the attacks with functional left ventricular insufficiency. Typical cardiac asthma is rare with right sided heart lesions (Wassermann, Weiss and Robb, Pratt).

2. Attacks occur characteristically, although not exclusively, at night and awaken the subject from sleep.

3. Attacks may occur in association with Cheyne Stokes respiration, and in these cases diminished sensibility of the respiratory center, "slumber apnea" may sometimes be a factor in precipitating an attack (Hoover, Wassermann).

4. Attacks may occur in patients with edema. Mobilization of clinical or occult edema fluid while the patient is at bed rest may play a role in initiating an attack by overloading the left ventricle (Volhard, quoted by Brunn, and Brunn).

5. Patients with low serum proteins are more likely to develop pulmonary edema with the attack (Weiss and Robb).

It is not surprising that cardiac asthma should occasionally complicate severe pre-eclampsia for many of the factors which are thought to predispose an individual to an attack irrespective of pregnancy are present in pre-eclamptic patients. The latter have hypertension, albuminuria and edema. Placing such a patient at bed rest usually results in rapid mobilization of the edema fluid as is evidenced by rapid weight loss and diuresis. Both Volhard and Brunn have suggested apropos of classical cardiac asthma, that bed rest results in mobilization of occult edema fluid and that this causes a hydremia which may precipitate an attack by overburdening the left ventricle. We have observed marked fluctuations in the hematocrit reading in eclamptic patients as they developed pulmonary edema. The frequent occurrence in the toxemic patient of a tendency to cerebral edema and lethargy might favor the slumber apnea mechanism of an attack. Low serum proteins a factor which is stated to favor the development of pulmonary edema with cardiac asthma, is present in toxemic patients.

In cases of pre-eclampsia complicated by attacks of cardiac asthma long standing insult to the left ventricle is absent. If left ventricular insufficiency plays a dominant role in the etiology of the attacks it must be brought about within a brief period of time. Two mechanisms suggest themselves either or both of which might be operative in causing such insufficiency. First the effect of increased work due to the sudden imposition of marked hyperpiesia upon a relatively normal

heart muscle must be considered. Second, the metabolic changes of severe toxemia may result in cardiac edema and other as yet unknown changes which decrease cardiac efficiency. The tempting theory of an acute "toxic myocarditis" cannot be excluded. Convincing pathological confirmation of this latter explanation is wanting. However, the heart muscle in our case which came to autopsy showed marked edema and focal leucocytic infiltration which might be regarded as consistent with such a mechanism. Acute degenerative changes in the heart are commonplace in autopsy material from eclamptics.

The occasional occurrence in pre-eclampsia of cardiac asthma with acute pulmonary edema suggests that left ventricular embarrassment may be an important cog in the mechanism of acute pulmonary edema, both in these unusual cases of pre-eclampsia and in eclampsia. The fact that 4 of our 6 patients recovered following the attacks indicates that acute pulmonary edema is not necessarily terminal in character. It also suggests that the cause of death in eclamptics who develop acute pulmonary edema may be acute heart failure of left ventricular origin.

#### TREATMENT

1. The immediate treatment of the attack is essentially that of classical cardiac asthma. Effective measures are the use of morphia in large doses, and either venesection or the use of peripheral venostasis.

2. If, as we believe, the attacks which we have described in these patients are similar in mechanism to those of classical cardiac asthma, it would seem that digitalization were indicated. We come to this conclusion for two reasons. First, because such attacks are thought by a number of internists to be associated with left ventricular insufficiency. Second, it has been shown, whatever the mechanism may be, that patients subject to recurrent cardiac asthma improve following the exhibition of digitalis. Both the number of the attacks and their severity are decreased (Harrison, Calhoun, and Turley). We also believe that the prophylactic use of digitalis in all eclamptics and those patients with severe non-convulsive toxemia in and above

the fourth decade of life should be considered.

3. From the obstetrical viewpoint, termination of the pregnancy soon after the attack is indicated. It is our limited experience that significant clinical improvement is not to be anticipated until the uterus is emptied. The optimum time for interference would seem to lie between 12 and 48 hours after the attack. This gives sufficient time for digitalization prior to interruption of the pregnancy.

4. Our patients were all severe toxemics with marked edema. It will be remembered that all of the observed attacks occurred during bed rest. Treatment had been directed toward elimination of edema by the use of saline cathartics and diuretics. This is well exemplified by the case of M. C., whose weight loss was 20 pounds during the first 48 hours after admission to the hospital. The elimination of edema fluid in cases of nephrosis and acute glomerular nephritis results in hydemia (Fishberg). It would seem possible that hydemia associated with rapidly diminishing edema in our patients may have been a factor in the production of the attacks by overloading the left ventricle. Such a mechanism has been suggested as an important factor in the precipitation of attacks of classical cardiac asthma by both Volhard and Brunn. These observations would suggest the exercise of caution in the use of methods directed toward the rapid mobilization of edema fluid.

#### PROGNOSIS

Two of our 6 patients died undelivered. The others recovered. The immediate prognosis, once a severe attack of cardiac asthma with pulmonary edema has occurred, is grave. However, if the patient survives delivery and the first few days of the puerperium the ultimate outlook is excellent. Three of our 4 patients who survived the immediate attack are alive and well without cardiac, vascular, or renal sequelae, 8, 6, and 2 years, respectively, after the attacks.

If the syndrome shown by these pre-eclamptic patients is identical with classical cardiac asthma, such patients would seem to offer a new opportunity for study of the mechanism involved. The brief course of the

hypertension, as well as the sudden marked alterations in tissue fluid exchange are in contrast to the longstanding cardiovascular and renal pathology usually encountered in cases of classical cardiac asthma. Also the methods which have been used in the study of the latter patients may be found useful in the investigation of problems related to the pathological physiology of pregnancy toxemias.

#### SUMMARY

1. Six case histories are presented in which severe non convulsive toxemia of pregnancy was complicated by one or more sudden paroxysms of dyspnea associated with acute pulmonary edema. In 5 of these cases the patient suffered from a simple pre eclampsia without preceding hypertension or nephritis.

2. The attacks all came on in patients at bed rest under treatment and closely resembled classical cardiac asthma.

3. The immediate prognosis for patients who develop this syndrome is grave. If they survive delivery and the early puerperium, the ultimate outlook as regards chronic cardiovascular and renal disease seems to be good.

4. Left ventricular failure may be an important factor in the precipitation of these attacks of 'cardiac asthma' in patients with severe pre eclampsia. It may also play a

dominant role in the production of acute pulmonary edema in eclampsia. The fact that a number of our pre-eclamptic patients recovered indicates that such left ventricular failure is not necessarily an agonal phenomenon.

5. It might be advisable as a prophylactic measure to digitalize all eclamptics, and those patients over 30 years of age who have severe toxemia.

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# PHYSIOLOGICAL CHANGES IN THE URETER ASSOCIATED WITH PREGNANCY

## The Relationship Between Atony and Dilatation of the Tract<sup>1</sup>

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MUCH has been learned in recent years concerning the relationship between upper urinary tract disease and pregnancy. It is now generally recognized that during pregnancy changes of marked significance occur in the anatomical and physiological relationships of the whole tract. Some of these changes are so constantly observed as to justify the classification of them as physiological, on the other hand, in so far as they predispose the woman to disease, they must be considered pathological and so come within the scope of interest of all those concerned with pregnancy and its complications. As one evidence of this altered physiology, we have become quite familiar with the so called "hydro-ureter of pregnancy," which is characterized by a marked increase in the fluid containing capacity of the abdominal ureter and the kidney pelvis, and may be demonstrated during the second and third trimesters of pregnancy in at least 75 of every 100 pregnant women. It has also become very evident that this widening and elongation of the tract is a disadvantageous development, as it is associated with stasis of urinary fluid and favors the growth of pathogenic micro-organisms in this stagnant medium. A knowledge of the underlying physiology of the urinary tract in pregnancy has, therefore, assumed added importance, as an understanding of these changes is a fundamental necessity if urinary infections are to be prevented or adequately treated.

In a recent communication, the authors gave an account of their observations upon the physiological changes occurring in the

ureter in pregnancy and demonstrated that the ureters of most pregnant women undergo a progressive diminution in peristaltic activity from the third month of pregnancy onward. In some of the patients studied this diminution amounted to complete atony, in others it was more moderate, while in a very few, normal peristalsis existed throughout pregnancy. The majority, however, showed a definite reduction of response on the part of the ureteral musculature which reached a maximum at about the middle of the third trimester, after which time there was a gradual increase in the muscular activity of the tract. This phenomenon was considered in its possible relationship to gestational dilatation of the ureter, stasis of urine, infection, and pyelitis. The view was expressed that this atony was not the result of over-stretched ureteral musculature, but was in all probability a primary phenomenon which, operating co existantly with the weight of the pregnant uterus resting upon these tracts as they crossed the pelvic brim, brought about ureteral dilatation and urinary stasis. The cause of the atony was thought to be hormonal in nature.

This paper was in the nature of a preliminary report and left unanswered many questions, such as the date of appearance of atony in early pregnancy and its duration in the puerperium. It was necessarily incomplete because its observations were based upon a relatively small number of patients, as well as from the point of view that no considerable group of patients was followed throughout pregnancy with multiple observations upon each individual. For these reasons the work has been continued so that information can now be given in more complete and exact

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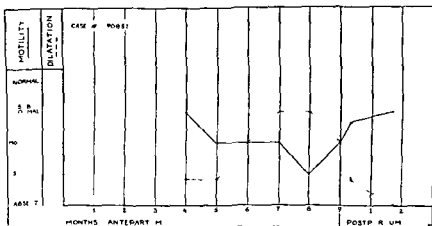


Fig. 1. A graphic representation of the observations made upon a young primi gravida. At the first examination, in the fourth month of pregnancy peristalsis was somewhat abnormal and there was slight dilatation of the right ureter. As the ureter became more quiescent the dilatation increased. Abruptly at the eighth month the process was reversed the motility and size of the ureter becoming normal 6 weeks postpartum.

form and, in addition new observations are possible.

Fourteen normal gravid patients were selected who gave no evidence of urinary tract abnormalities, past or present. Six of these were pregnant for the first time, while the remainder were multigravida. The degree of parity together with the relationship of our observations to the stage of pregnancy are indicated in the protocol. In general it may be said that they were secured as early as possible and studied at monthly intervals throughout pregnancy and the puerperium. Another group of 14 patients was observed at longer intervals but for these the data are fragmentary and therefore can be used only as corroborative evidence. The original group of 7 normal non pregnant women was used as a control to establish the normal basis for our instruments and technique.

As in our previous work, the Trattner hydrophorograph, a form of recording kymograph combined with an electrical drop-counting device, was used. It was connected with a No. 7 whistle tipped intra ureteral catheter, the tip of which lay just above the pelvic brim. This position of the catheter theoretically made possible a record of the summation of all fluctuations of intra ureteral pressure. In this way we have recorded the pressure changes of the tract as a whole in contrast to

those of any single portion, and in these records have an expression of the muscular activity of the tract. Care was observed to insure that at each observation the patient had ingested copious amounts of water. In addition, whenever ureteral activity was absent or at a low level, attempts were made to stimulate peristalsis by momentarily raising intra ureteral tension by means of injections of normal saline solution. The procedure of recording the kymographic tracing was followed always by retrograde pyelography and in this way, data were collected which enabled us to evaluate the relationship between the degree of ureteral dilatation and the irritability of the ureteral musculature. The method also acted as a check upon the level occupied by the tip of the catheter. Bacteriological cultures and microscopic examination of ureteral and bladder urine served as a control as to the presence or introduction of infection. It will be of interest to note that these rather extensive and frequently repeated manipulations did not bring about a single instance of infection which was demonstrable by these bacteriological methods.

In making the record of peristaltic activity, the same technique was observed as in the former study, with regard to various levels of intra ureteral pressure. At the beginning of the record, the level was maintained at ap

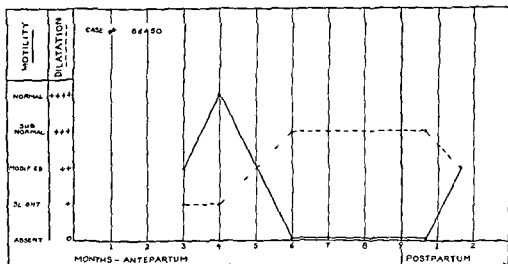


Fig 2 This graph, also from a primigravida, shows a complete loss of peristalsis from the sixth month onward to the third week of the puerperium, associated with a continuously dilated ureter. This is unusual as the return toward normal usually commences at about the eighth month of pregnancy.

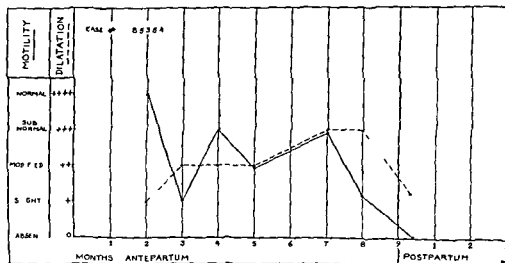


Fig 3 The data from Patient No 85354, a multipara when plotted show a moderate loss of motility of the ureter from the third month, associated with a medium degree of hydro ureter.

proximately 15 centimeters of water for 3 minutes, then dropped successively to 10 and 5 centimeters for periods of similar duration. This was found important, as it was observed early in the study that each tract responded differently in some degree and that each was characterized by an ability to respond best at some particular level of intra-uretral pressure. The method provided a means of bracketing, so that the conditions for maximum response were afforded at some point during the making of each record.

Having gathered these data, it was then possible to make a graphic representation for

each patient of the variations in ureteral peristalsis, as compared to dilatation of the ureters at monthly intervals. Two curves were plotted on each chart, one based upon motility, and the other upon the degree of dilatation of the ureter, both being correlated to the duration of pregnancy and the puerperium. Figure 1 is a typical graph which illustrates the method. From an examination of this chart alone, one would conclude that motility and dilatation of the ureter were inversely proportional. In other words, it would seem that as motility, or perhaps more correctly, as muscular activity decreased,



### 5.2.2. TABULATION OF THE DATA FROM THE POLLURIT PROGRAMS AND HYDROLOGICAL DATA

[illegible]

TABULATION OF THE DATA FROM THE PYELO URETROGRAMS AND HYDROPHORAGRAPHIC TRACINGS—Continued

No. Gin vility	Ureter status	Months of pregnancy						Weeks of puerperium					
		1st Trimester		2nd Trimester		3rd Trimester		1st		2nd		3rd	
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
7068	Dilatation							No picture					
7118	Motility							Absent					
7218	Motility							No picture					
7318	Motility							Absent					
7418	Motility							No picture					
7518	Motility							Absent					
7618	Motility							No picture					
7718	Motility							Absent					
7818	Motility							No picture					
7918	Motility							Absent					
8018	Motility							No picture					
8118	Motility							Absent					
8218	Motility							No picture					
8318	Motility							Absent					
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8918	Motility							Absent					
9018	Motility							No picture					
9118	Motility							Absent					
9218	Motility							No picture					
9318	Motility							Absent					
9418	Motility							No picture					
9518	Motility							Absent					
9618	Motility							No picture					
9718	Motility							Absent					
9818	Motility							No picture					
9918	Motility							Absent					
10018	Motility							No picture					

The dilatation of the ureter was calculated at the widest part of the abdominal spindle and designated as + + +, etc., an additional + being given for an increase of about  $\frac{1}{2}$  centimeter in diameter.

The peristaltic tracings were evaluated according to the height and frequency of the curves and designated as normal subnormal, modified, slight or absent. From these data individual graphs were prepared for each patient. Examples of these graphs may be seen in Figures 1 to 4. A consolidation of all data was plotted and is represented in Figure 5.

dilatation of the ureter increased, and *vice versa*.

Figure 2 shows much the same course of events, except that at the last observation, 6 weeks postpartum, the ureter had not returned to normal in respect to its dimensions or its motility. This observation is quite a usual one, as a study of the series as a whole clearly shows (Fig. 5, composite graph).

Figure 3 tells a somewhat different story, as it may be seen that after the initial drop in motility accompanied by a moderate degree of dilatation of the ureter, the variation of these from the non-pregnant normal is not in an inverse relationship to one another but is roughly parallel. This relationship is not frequently seen but evidently is one of the possible variations and represents a borderline condition with some decrease in motility accompanied by a moderate dilatation of the ureter.

Other interesting variations were encountered of which the graph shown in Figure 4 is an example. In general, these curves correspond with those shown in the first two graphs, but at the sixth month there is a marked decrease in motility associated with a moderate decrease in caliber of the ureter. Efforts to stimulate the ureter at this point by sharp increases in intra-ureteral tension produced by injecting normal saline solution into the ureter, were unavailing. The only conclusion possible appears to be that there probably are marked variations in every patient. This point of view brings out the necessity for many observations before drawing conclusions, as well as the importance of studying large groups of women.

These variations from the usual experience also point out the importance of composite representations of the findings of the group as a whole. These may be seen in Figure 5, which establishes the first two graphs shown as relatively normal and, in addition, gives important information with regard to the puerperium.

It will be seen that in the group of patients as a whole, Figure 5, the degree of dilatation of the ureter is, generally speaking, proportional to the diminution in ureteral activity. This relationship is a progressive one up to

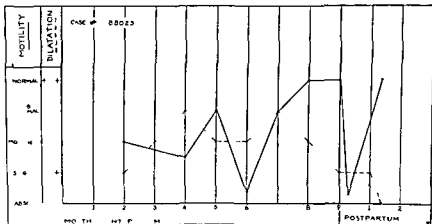


Fig. 4. This graph shows a moderate loss of motility associated with some dilatation of the ureter as early as the second month of pregnancy. There is a remarkable recovery of peristalsis after the seventh month, with marked decrease in the size of the ureter. This graph also shows the initial postpartum atony.

the seventh month of pregnancy. From this point onward the decrease in size of the ureter is continuous until involution is complete in the seventh week of the puerperium. The muscular activity, on the contrary, does not follow an uninterrupted return to normal, for it is an almost constant finding that the ureter is marked by atony for a period of about 3 weeks postpartum. It then returns rapidly to normality which is reached at approximately the seventh week of the puerperium.

The conclusion that these two phenomena, atony and dilatation of the ureter, are intimately related seems unescapable. However, it is not quite as obvious which is cause and which effect. It is well known that an overdistended smooth muscle viscus quickly loses its peristaltic activity and eventually may become completely atonic if the distention be long continued. Further, it is known that distention of such a viscus may come about in two ways, or in combinations of both, namely, obstruction and loss of muscle tone. In early pregnancy, during the third and fourth months, there is no obvious obstruction of the ureters, the uterus being too small to produce any considerable occlusive effect and yet we frequently see dilatation at that period, whereas in the later months, when the weight of the organ is considerable and may exert a very marked pressure upon the lumina

of the ureters, we see a constant diminution in the degree of distention of these tracts. One concludes that the weight of the uterus bearing upon the tracts is not a satisfactory explanation or, indeed, a considerable factor in bringing about the condition.

On the other hand, there is a loss in muscle tone early in pregnancy which is practically coincident with the onset of dilatation. Furthermore, after the seventh month when the weight of the uterus is constantly increasing, we see a return of regular ureteral peristalsis and associated with it, a distinct and almost constant decrease in dilatation of the ureter. It is apparent, therefore, that the explanation of the cause of dilatation was the loss of tone on the part of the musculature. It is obvious that this line of reasoning and these findings do not rule out the weight of the uterus as an augmenting factor in the production of the hydro ureter of pregnancy but they do clearly indicate that this time honored explanation is incomplete and somewhat far from the truth. At the same time, they indicate very definitely that muscular atony is, in all probability, primary, with dilatation of the ureter as a secondary development the whole process being affected in varying degree by the weight and torsion of the pregnant uterus.

Having come to the above conclusion based as it is on the observations of this study, one

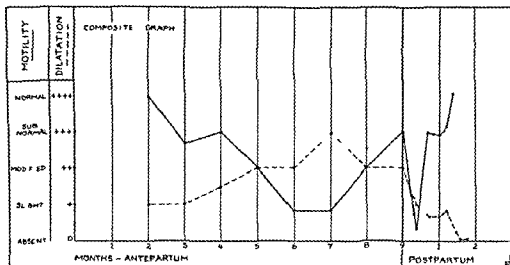


Fig 5 This is a composite graph made from the data of the 14 women followed in this study. Its main characteristics indicate clearly the conclusions which have been drawn, particularly the inverse relationship between the motility of the ureter and its dilatation, time relationships and the postpartum return of atony with recovery about the sixth week of the puerperium.

would like to know the ultimate etiological factors. If the atony of the ureteral musculature is not the result of the distention of the organ, what then is its cause? We do not know.

In our previous paper, it was suggested that the hormones and sympathetic nervous mechanism involved in the relaxation of the uterine musculature in pregnancy might, if completely understood, furnish the explanation or at least a clue. In view of our lack of information, it is perhaps wise not to speculate. However, the many analogies between the activity of the two organs seem to have more than coincidental significance. The fact that bilateral ureteral atony is coincident with pregnancy and seldom seen outside pregnancy except in conditions associated with marked obstruction of the tracts, is significant. It is also striking that in pregnancy, the muscular activity of the uterus and ureters is almost parallel, in that the ureter recovers from its atonic phase at the time the Braxton Hicks contractions of the uterus become evident, and then again becomes quiescent when the possible reflex stimulus of the Braxton Hicks and labor contractions have abated. However, these are nothing more than interesting observations and, while they may be significant, they do not furnish proof of the relationship or etiology of the ureteral atony of pregnancy.

The discovery that the ureter undergoes a secondary phase of inactivity in the puerperium was wholly unexpected and may be of importance in explaining the incidence of postpartum pyelitis, as it again allows stasis of urine to occur. The cause of this secondary lapse is also unknown, but as suggested above, it may be due to removal of the reflex stimulus of the rhythmic uterine contraction, on the other hand, it may be explained by the trauma of the pelvic ureters with subsequent edema resulting from childbirth. Curiously enough, it is not usually accompanied by an increased dilatation of the ureter during this phase, although involution of the ureter does appear to be at a standstill during its course. As is indicated in the graph, the ureters of the normal puerperal woman reach the limits of normality as regards motility and the contours of the tract during the second month after delivery.

# CONCLUSIONS

1 New evidence is brought to light indicating that the physiological dilatation of the ureter in pregnancy is not due to the weight of the pregnant uterus primarily, although this is undoubtedly a contributing factor.

2 The characteristics of the ureteral atony are thought to be similar in many respects to that affecting the uterine musculature. It is

suggested that the phenomena in the two organs may have a similar etiology which is unknown

3 The ureteral dilatation is roughly proportional to the degree of atony and both appear and disappear at similar times with regard to the course of pregnancy

4 Dilatation and atony appear in the third month and are progressive to the seventh month of pregnancy. During the last 2 months, there is a marked increase in motility, accompanied by a moderate decrease in the dimensions of the tract. Following delivery, atony is again marked until the third week, subsequent to which motility returns rapidly to normal levels, which are usually attained during the sixth or the seventh week postpartum. Dilatation of the tract decreases progressively after delivery and reaches practically the normal values at the seventh week of the puerperium

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# CLINICAL SURGERY

FROM THE SURGICAL SERVICE, ST JOSEPH'S HOSPITAL

## CLOSURE OF COLOSTOMY

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THE manufacture of an enterostomy for decompression of an obstructed bowel is one of the oldest of operations. Litteré visualized the necessity of this type of surgical procedure when he observed a congenital division of the rectum of a dead infant who had lived 6 days. He proposed bringing the upper part of the intestine out on the abdominal wall where it would never close, but would take on the function of an anus.

Actually, Litteré did not perform this operation, but Pillore, in 1776 did the first cecostomy, in the right iliac fossa. Cecostomies for imperforate anus had been done by Dubois and others before Amussat, in 1839, actually established the place of colostomy in surgery. Over a long period of time down to the present, there has been a uniform lack of appreciation of colostomy as an essential step in the extirpation of rectal cancers, but today it is generally recognized that either a single barreled or loop colostomy is an essential part of any radical extirpative maneuver directed against malignancy of the lower gastro-intestinal tract.

When colostomy is done as a sidetracking operation of a temporary nature or when a colon has been resected by an obstructive type of resection or an exteriorization variety of maneuver (Fig. 1, a and b), the necessity of closure of the colostomy and re-establishment of the continuity of the gastro-intestinal tract presents several interesting problems. After an obstructive resection or an exteriorization resection if one waits a sufficiently long period of time there are usually three factors which are responsible for failure of these artificially made fistulas to close: first, obstruction due to spur formation in the bowel; second, attachment of the mucous membrane of the bowel to the skin edges; and third, obstruction distal to the opening.

The spur formation should be cut out as deeply as possible with an enterotome and if the mucosa

is attached to the peritoneum and muscle layers, spontaneous healing will occur in the majority of cases. Obstruction below the colostomy may be due to a neoplasm, stricture, or angulation of the bowel produced by adhesions or occasionally by fecal impactions.

One practical point which seems worthy of emphasis is the length of time which one should wait before attempting to cut out the spur of the colostomy. The general tendency not only of the patient, but of the surgeon also, is to hurry to finish the operative procedure. When one considers the great amount of edema which is present in and between the two loops of bowel after the operation has been accomplished, one realizes that it is a matter of several weeks' waiting before the spur may be safely and deeply incised. Six weeks or 2 months is not too long in the majority of cases to wait before application of clamps, and during this time the patient returns home to a normal mode of life and acquires a bowel habit suitable to his new colostomy surroundings. As a result of this policy of delay more than one-half of the fistulas which we have made following obstructive resection have closed spontaneously. For those which do not close spontaneously after a reasonable length of time, or for those in which the indications seem to favor a deliberate closure of the colostomy by suture, we have found some points in technique which are described here and which have served us advantageously in a reasonably large series of cases.

In contemplating closure of colostomy, especially if the operation has been made through the rectus muscle—(we have long since abandoned this incision for colostomy)—preparation should be made for a more formidable procedure because it is frequently necessary to repair a ventral hernia in this location in addition to a plastic operation on the bowel. If a stab wound has been made or a muscle splitting incision used, herniation is almost never seen. Primary healing of

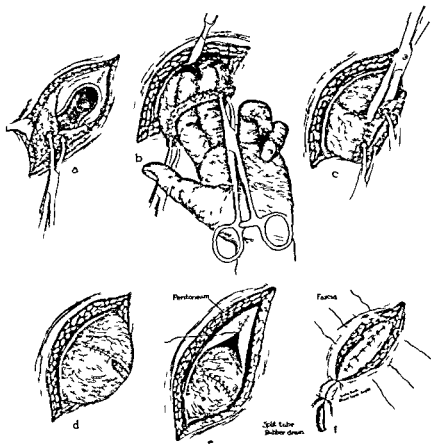


Fig 3 Closure of colostomy a Elliptical incisions encircle the stoma and extend down through the fascia and muscle b the index and middle fingers of the left hand inserted into the two loops of bowel act as tractors and facilitate dissection c mobilization complete the edges of the bowel ends are trimmed clean of the margin of skin d the opening in the colon is sutured with two rows of chromic catgut in the transverse diameter of the bowel e the sutured bowel is replaced in the abdominal cavity and the peritoneum sutured with catgut f the fascia is closed with interrupted sutures of catgut and wicks of rubber tissue placed down to the fascia

flushed out with large quantities of warm normal saline solution, followed by ether. The fascia is closed with interrupted sutures, leaving sufficient space between to permit escape of gas and feces to prevent obstruction. Wicks of rubber tissue are placed down to the fascia to be removed after 48 hours (Fig 3, f). The edges of the skin margins are approximated loosely.

A decided improvement in the healing of these wounds has been noted during the past 2 years since we adopted exposure of the wound routinely to infra red rays commencing 24 hours after operation and continuing its daily use for 7 to 10 days. Enemas and laxatives are strictly avoided.

We no longer withhold food from these patients over a long period of time, for peristalsis in the colon, while it may be inhibited by drugs, continues to a certain extent whether food is ingested or not. Moreover, it is our impression that leakage at the site of anastomosis is less likely to occur if the fecal content is solid.

Mortality from closure of colostomy is extremely low and usually is the result of some complication, such as embolism, pneumonia, etc. Peritonitis is a most unusual complication in our experience and rarely occurs. Moreover, the percentage of closure by primary union is remarkably high.

# PARTIAL GASTRECTOMY IN ACUTE PERFORATED PEPTIC ULCER<sup>1</sup>

Observation on Diagnosis and Treatment of 426 New Cases

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**E**MERGENCY surgery for the three and a half million inhabitants of Moscow is now concentrated at the Central Emergency Hospital, hence the number of dangerously ill patients brought to this service grows every year. This statement is confirmed by study of a curve showing patients registered with acute peritonitis resulting from perforation of duodenal and gastric ulcers (Fig 1). With this wealth of material, consisting of patients who have been treated under absolutely identical conditions, it has been possible to make a number of observations which should be convincing.

The great number of patients seeking treatment for perforated ulcers has permitted me to apply a method of surgical treatment which has been used but little hitherto, namely primary partial gastrectomy with removal of the upper part of the duodenum. I began using this method in 1928 and since then have reported, both in domestic and foreign journals, large series of cases almost yearly.

Twenty years of active interest and work in gastric surgery long ago convinced me that even in duodenal ulcer the ultimate results of conservative treatment are bad. The disappearance of all symptoms of disease in 75 to 80 per cent of our cases which we observed during the first 2 years after gastrojejunostomy fell to 50 to 60 per cent cures when we examined them 5 or 6 years after operation, and when my assistant, Dr S J Terakopof, examined the patients 10 to 12 years ago after operations in Serpukhof he found only half of the patients operated upon to have been completely relieved. Many of them had to be operated upon again, radical gastrectomy became necessary under conditions far worse than those that would have been met had gastrectomy been performed at the onset, when resection would not have been complicated by the existing gastrojejunal stoma.

The conditions are still worse when the gastroenterostomy is complicated by a marginal ulcer. According to the records at my disposal marginal ulcer develops in approximately 5 per cent of cases

after gastro-enterostomy. In such cases operation is quite indispensable, and carries with it a considerable operative mortality as the procedure is technically difficult. It is a striking fact that such peptic ulcers develop much more often after gastro-enterostomy for duodenal ulcer than they do after gastro-enterostomy for gastric ulcer—a circumstance which is explained by the fact that the aggressive acid-pepsin factor of ulcer disease is as a rule more pronounced when the ulcer lies to the right of the pylorus. Secondary peptic ulcer is especially imminent when gastro enterostomy has been performed on patients with abnormally high acidity, particularly if the patient is young and has a relatively short history of ulcer. In such cases partial gastrectomy with restoration of continuity after the Billroth I method has every advantage.

Such patients may be recognized by careful study of stomach secretion before operation by means of fractional analyses with a Rehfus tube in various phases of digestion and by means of various food irritants. Examinations of a similar character can always be made in chronic cases, in which there is no danger of hemorrhage or of perforation.

It is obvious that the necessary data cannot be obtained from patients who come with an ulcer already perforated into the abdominal cavity. The majority of such patients, as we shall show later, are precisely those suffering from duodenal ulcer and most of them are youthful. Mere suture of such an ulcer leaves unchanged all conditions under which it occurred. A supplementary gastro enterostomy may be required immediately owing to contraction of the duodenum after suture. Gastro enterostomy gives good results in elderly patients with enlarged stomachs resulting from old scar constriction at the seat of a duodenal ulcer, but in young patients it displays all its defects. Therefore, there are always grounds for considering primary resection even in a stage of acute perforation and developing peritonitis, if the time which has elapsed after perforation and if the general condition of the patient warrant such intervention.

<sup>1</sup>From the Central Emergency Hospital (Institute Sklifasovskiy)



The following hitherto unpublished data prove that our tactics have been justified by the new series of cases covering the period for 1933 and 1934. In these 2 years we had in our hospital 426 patients with acute perforated ulcers: 273 in 1933 and 153 in 1934. Of these only 9 were women. The rare incidence— $1\frac{1}{2}$  to 2 per cent—of perforated ulcers in women has been found the same in our whole series of cases now over 1000 in number. It is interesting to note that of patients coming to our hospitals with chronic ulcer about 10 per cent were women. Thus it is apparent that not only is ulcer much rarer in women, but that the incidence of perforation is even lower than in men.

In Figure 2 is shown the age incidence of perforated ulcer cases in 1933. There were few patients under 20. After this age there was an immediate increase in the number of perforations and in the following decade the increase was still more marked. After the age of 40 the number of perforations noticeably diminished.

This diagram also reveals two other interesting facts: (1) The number of perforated stomach ulcers is only 10 per cent of the duodenal perforations (on the chart, stomach ulcers are shown by black circles and duodenal ulcers by rings, the 3 cancerous ulcers are shown by shaded rings). (2) In youth stomach ulcers are rare; as age advances the number of perforated stomach ulcers grows and in the age period of over 50 they even exceed duodenal ulcers. This fact is also corroborated by my statistics based upon a study of over 1000 cases.

Seasonal incidence of perforation has only recently been studied. Because of our large series of cases in 1933 we decided to analyze our previous material, and we found that there was a certain regularity with which perforations occurred—perhaps attributable to conditions peculiar to Moscow. It seems that the number of perforated ulcers maintains a rather steady average during the autumn and winter months. In the second half of winter, however, the number begins to increase and reaches its maximum in the spring. During the summer months the number of perforated ulcers gradually decreases and the minimum is reached in August. It is true that under severe winter conditions with a shortage of vegetables and fruits there results an increase in avitaminosis, which is more marked in the late winter months. The appearance of vitamin-containing foods in the spring quickly lessens the number of perforations.

Of still greater interest are the data shown in Figure 4 concerning the relation of perforation to

meal times. Perforations rarely happen at night; after breakfast the number rapidly increases. The second and bigger wave of perforations occurs in the hours after the main midday meal and decreases toward evening, then to increase again after supper.

Usually it is not difficult to diagnose perforated ulcer. There is sharp, acute pain which comes on quite suddenly and usually involves the whole abdomen. More rarely the perforation is preceded by an increase of the familiar hunger pain followed by a feeling of general discomfort, and in these cases a rise in a previously normal temperature.

The sudden pain in the abdomen is often associated with pain radiating into the arm, shoulder, or shoulder blade, the pain being caused by irritation of the ends of the branches of the phrenic nerve, which arises from the fourth and fifth cervicals. This symptom is characteristic of the condition and is essential in distinguishing between the presence of perforated ulcer and of acute appendicitis.

The chief symptom of perforation is the cramping and straining of the abdominal wall, a symptom noted immediately following perforation. Tension is maintained without diminishing during the development of intra-abdominal inflammation, thus the increase or decrease of tension may indicate definitely whether the peritonitis is waxing or waning. Since infection spreads from a perforated duodenal ulcer down along the right large intestine and since the exudate may be concentrated in the cecal region, this is often the place most sensitive to palpation and here also the most acute *defense musculaire* is found. To differentiate between perforated ulcer and acute appendicitis the pulse is especially useful; it remains full, slow, even abnormally slow in perforated ulcer while it is accelerated in appendicitis. The tongue dry in appendicitis, always remains moist with perforated ulcer. In the latter, vomiting is also extremely rare while it is seldom absent in peritonitis due to other causes.

A sign conclusive of perforated ulcer is the presence of free gas in the abdominal cavity. The presence of gas can be determined by percussion over the right lower ribs, where it forms a high tympanic tone on the surface of the liver, or it can be detected by x-ray examination. This last method gives indisputable data in 80 to 85 per cent of cases. If one cannot detect a translucent line of gas between the diaphragm and the liver in a dorsoventral roentgenogram in the erect position, favorable results may sometimes be ob-

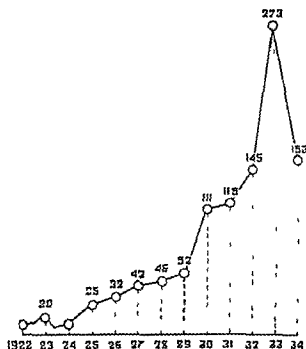


Fig. 1 Chart showing number of cases of perforated ulcer from 1922 to 1934

tained by a similar roentgenogram with the patient lying on his left side, or with a roentgenogram in the frontal position with the patient lying on his back.

When diagnosis is difficult the greatest importance must be attached to the history. Although some patients, seized by terrific pains, declare they never had symptoms of ulcer before, persistent questioning usually elicits some complaint of previous dyspepsia. Positive anamnestic data can be obtained from 95 per cent of patients suffering from perforated ulcer.

Patients suffering from perforation cannot be prepared for operation because they are operated upon the moment they are brought to the hospital. The great majority of patients are brought to our Institute within 6 to 8 hours of perforation, more rarely after 12 to 18 hours, and only in exceptional circumstances on the second day.

Among the *methods of anesthesia* for operations for perforated ulcer, we use mainly two: spinal anesthesia and local anesthesia combined with initial ether. In 20 consecutive unselected cases pure local anesthesia was quite successful; the intercostal nerves were blocked on both sides with novocain, the peritoneum was methodically injected after the abdominal cavity was opened, and the splanchics were also blocked, thus permitting me by careful manipulation to wall off the abdomen with gauze with absolutely no pain to the patient. No one of these patients disturbed

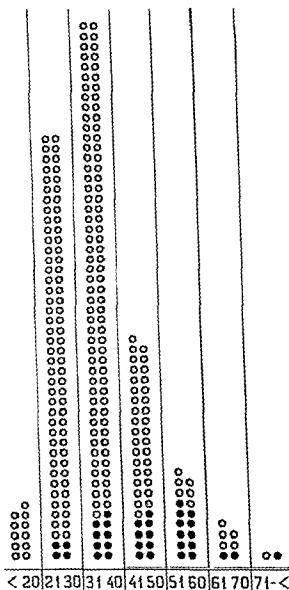


Fig. 2 Age incidence

me during the performance of the operation, and all of them recovered.

It must be said, however, that the use of local anesthesia alone is troublesome and time consuming, requiring much application and patience on the part of the surgeon. It is much simpler to combine general narcosis with regional anesthesia of the abdomen, to put in the necessary packs and after that to inject novocain into the small omentum, close to both gastric arteries. From that moment on the mask may be removed from the patient and resection may be undertaken without narcosis. This method has given beautiful results in many hundreds of operations for perforated ulcer in which it has been used; it requires merely a sufficiently experienced person to give the general anesthetic.

At night when our best anesthetists may not be

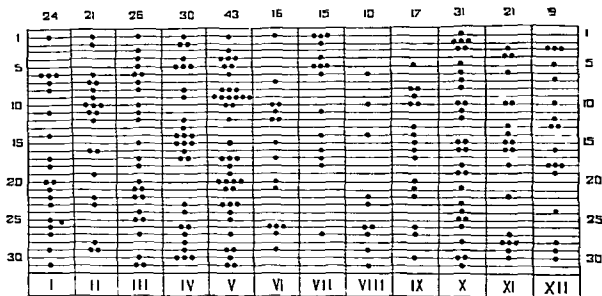


Fig. 3 Seasonal distribution

at hand it is better to use spinal anesthesia rather than leave anything to chance. This method gives more complete relaxation of the abdominal wall than does any other method of narcosis. It ensures perfectly painless walling off of the operative field and is the best guarantee against subsequent peritonitis.

The use of spinal anesthesia is rarely contra-indicated by low blood pressure, provided, of course that operation is performed sufficiently early. This concerns chiefly young patients. Old persons generally stand spinal anesthesia well thanks to their hypertension. We formerly used tropococaine the only fault with which was that analgesia sometimes gave out before operation was finished. Of late we have used a 1 per cent solution of percaine which gives anesthesia for several hours. Preliminary injections of ephedrine are necessary to prevent collapse. Both for the operation itself and for the packing off of the abdominal cavity spinal analgesia guarantees the best conditions, therefore we have come to prefer it to all other methods.

The packs put in at the beginning of operations remain in place until the operation is over. And that is the whole toilet of the abdominal cavity. The abdominal cavity is invariably closed with out drainage.

With regard to the question of the *method of operation*, I shall refer to what I said above as to the desirability in principle of partial gastrectomy, as against simple suture of the ulcer and gastro-enterostomy. The contra-indication against ra-

dial operation in special cases remains to be discussed.

*Duration of perforation is the chief*, but not the only factor determining the method of operation. The quantity of fluid which has escaped and the degree of intoxication vary. Some patients have a large perforation in others it is small. Some perforations are wide open, others are covered from time to time by pieces of food, by fibrinous layers of adjacent organs. The quantity of fluid expelled also depends upon the content of the stomach before perforation. And finally virulence of infection and resistance of patients have all possible gradations.

It follows therefore that in perforations of equal duration the gravity of the developing peritonitis and the general state of the patients may be quite different. In the majority of cases the severity of intoxication may bear a direct relation to the time element but at times it will be found that this relationship may vary widely in both directions. Therefore, only a most careful clinical study of the case in question will determine whether a radical operation or a minimal intervention should be done. I would emphasize that the age factor plays a very important rôle, I would prefer to do a resection on a young patient even in the tenth or eighteenth hour after perforation than to do the same operation on an old patient in the very first hours after perforation has occurred.

As far as the resection itself is concerned in most instances it is not technically difficult. In most

perforation cases the duodenum is movable or easy to mobilize. Ulcers of the posterior wall of the duodenum which are attached to the pancreas are almost never perforated. The same is true of stomach ulcers if they lie posteriorly or high up on the small curvature they often penetrate into the pancreas and liver and are not inclined to perforate openly, an acute, perforated stomach ulcer usually lies free in the pyloric part of the stomach and presents no difficulty in resection.

These peculiarities explain not only the fact that 80 per cent of our series of operations were resections, but also that when performing gastrectomy we can ordinarily complete the procedure by an easy anastomosis of the gastric stump directly with the duodenum.

Of the 273 patients suffering from perforated ulcer during 1933, 266 were operated upon, while 7 were not operated upon, either because they were moribund, or because their symptoms were clearly diminishing, of these 7, 5 died. Of the 266 operations, 210 were resections, of these 193 were completed according to the method of Billroth I and the remaining 17 by the Pólya-Balfour method.

In 1934 there were 152 operations, 1 other patient was moribund. Of these 152 operations, 121 were resections, 300 by the Billroth I method and 21 by the Pólya-Balfour method.

In 1933 of 210 resection cases, 18 patients died, that is 8.5 per cent. In 1934 of 121 resection operations, 8 were fatal, a death rate of 6.6 per cent.

Our results for the last 2 years are thus: 331 resections for perforated ulcers with 26 deaths, that is 7.8 per cent.

For the same 2 years, of the remainder of the patients, 35 had a suture of the ulcer and gastroenterostomy and 5 perished. Fifty-two (40 plus 12) patients with perforated ulcers were submitted to suture only. Of these 23 died (18 plus 5). By adding together these groups of conservative operations, the following result is obtained: 35 plus 52 equals 87 operations, 5 plus 23 equals 28 deaths, that is 32.2 per cent. This considerable difference in the results obtained with the radical and the conservative operation can best be explained by the different conditions of the patients in the two groups: gastrectomy was performed in the more recent cases and for the most part the patients were young, while conservative operations were performed on the elderly patients or when advanced peritonitis was present.

One might expect that such radical procedures—primary resection performed on over 80 per cent of perforated ulcers—would be followed by

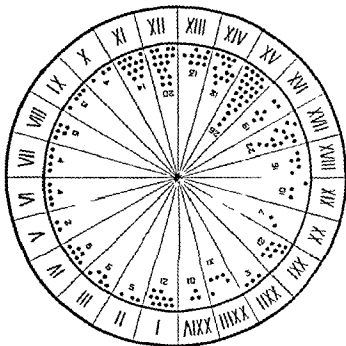


Fig. 4 Occurrence of perforation in reference to meal time

serious after-effects. Not only was this not true, but the mortality noted in earlier years, when only conservative operations were performed for perforated ulcer, has been considerably reduced. Thus, for instance in 1922–1924 our Institute had a mortality of 50 per cent in perforated ulcer.<sup>1</sup> This corresponds in general to the deaths reported in the symposium on perforated ulcer at the XXth Russian Congress at Moscow in 1928 (37, 40, 42, 50 per cent). At the same Congress statistics of the late V. A. Krasinzeff showed only 24.4 per cent fatal results for 128 cases of perforated ulcer in our Institute.

From 1928 on I have been systematically doing resections in all the earlier cases of perforation in young patients. The results of the first year (76 cases) were reported in Paris.<sup>2</sup> A comparative analysis based on 207 cases in our Institute shows a death rate of 11.9 per cent for resection—and a reduction of total mortality to 22.3 per cent.

A year later I published a study of 116 new cases.<sup>3</sup> The death rate for 98 cases of resection was nearly the same, 11.2 per cent, the general death rate of patients operated upon in this series had declined to 16.6 per cent.

I reported the next new series consisting of 212 cases of perforated ulcer in Paris on November 16, 1932, and in Barcelona, Spain, on December 5, 1932, at the Congress of the Medical Academy and Surgical Society. The general death rate for

<sup>1</sup>Tr. XVI Congr. Russian Surg. p. 445.

<sup>2</sup>Arch. klin. chir. 1930, 102, 517–530.

<sup>3</sup>de chir. 18 p. 250. Rev. de chir. Buenos Aires 1931, April p. 285.

this series was 11.8 and the 165 resections gave only 10 deaths, 5.9 per cent.

Going back to the statistics for the years of 1933-1934 we find a total of 426 cases of perforated ulcer (273 plus 152), and that 60 died (46 plus 14). In 1934, of 152 patients operated upon for perforated ulcers there were 13 fatalities, making a death rate of 8.5 per cent. This is the lowest mortality we have ever been able to obtain.

Summing up the general death rate for all operations for perforated ulcer in these last 2 years, we find 418 operations (266 plus 152), 54 deaths (41 plus 13), that is 12.8 per cent.

Thus it is clear that the radical operation in cases of perforated ulcer not only did not increase the general death rate, but that the death rate declined systematically every year, the data being based on a greater number of cases. The death rate has been reduced by one half since 1924-1928 and by three fourths since 1922-1924.

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\*Also published in Judin and Judine (in French journals).

# FRACTURES OF THE JAWS AND TREATMENT<sup>1</sup>

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**A**LTHOUGH fracture of the facial bones has occurred with increased frequency since the beginning of the twentieth century, this injury cannot be considered a product of our modern civilization. In the classical works of Hippocrates are found very accurate descriptions of methods employed in the reduction of mandibular fractures. Fundamentally, treatment today varies little from that advocated by the renowned Greek physician. The increased number seen at the present time may be attributed to the use of the automobile and aeroplane, the greater employment of machinery in industry, and participation in sports on a broader scale than ever before.

## MAXILLARY FRACTURES

The upper jaw is much less frequently subjected to fracture than the mandible. This is in part due to the strong support of the sphenoid, frontal, and temporal bones. Maxillary fractures may vary from a simple involvement of the alveolar process to a transverse fracture in which the bones are separated from their attachment to the skull. Fractures of the maxilla are classified as partial, complete, and comminuted. Due to the absence of muscular attachments, displacement is not as common a symptom as in the case of the mandible, but when present is due to gravity and the direction of the force. Traumatization of the infra orbital nerve may result in lack of sensation in the region in which it is distributed. Infection of the antrum, laceration of the tissues of the face, and loss of vitality of several teeth are some of the associated symptoms. Hemorrhage is usually easily controlled, but rupture of the internal maxillary artery has been known to result fatally. (2) Treatment, except in complete fractures, where it becomes necessary to go outside the oral cavity in order to effect immobilization, may be instituted by using intra oral methods which will be discussed in detail later in this paper.

## MANDIBULAR FRACTURES

The mandible, the largest and strongest bone of the face, because of its exposed position, is more frequently fractured than any of the other facial bones. It may be fractured at any point

from the symphysis to, and including, the condyle. In the majority of bilateral injuries the fracture on one side is in the canine region and at or near the angle of the other. The reason for this would appear to be the presence of the long cuspid tooth and submaxillary gland, which tend to weaken these particular portions of the jaw. A high percentage of fractures of the body of the mandible is usually compound, communicating with the mouth through the mucosa or alveolar sockets of the teeth. Most of the edentulous cases are of the simple or closed type. The etiological factor may be traumatic in nature as a blow or fall, improper technique in removal of impacted teeth, or pathological, due to neoplasms, cysts, or osteomyelitis. Certain bone diseases, such as rickets and osteomalacia, may be predisposing factors. The symptoms of fracture of the mandible are pain at the site of injury, tenderness on palpation, swelling, crepitus, impairment of function, numbness of the lip, and submucous or subcutaneous ecchymosis due to the effusion of blood to the surface. Probably the most common clinical observation is abnormal alignment of the teeth. The diagnosis should always be confirmed by a roentgenogram.

The complications of mandibular fractures are hemorrhage, cellulitis resulting many times in suppuration necessitating incision and drainage, osteomyelitis, and non-union. Teeth in or near the line of fracture often are a source of infection. If removal would cause excessive displacement, it is better for a time at least to let them remain. Frequent roentgenograms should be taken to note the alignment of the fragments, the formation of osseous tissue about the fracture line, and, when complicated by necrosis and infection, the presence and location of sequestra. In the diagnosis of fractures of the lower jaw, the x-ray is of inestimable value. The common practice of making two lateral jaw exposures does not in itself constitute a complete roentgenographic survey. As a result, fracture occurring in the region of the symphysis or at the neck of the condyle may be easily overlooked. Good x-ray plates of the temporomandibular joint may be obtained by using the regular mastoid technique or focusing the rays through the sigmoid notch of the opposite ramus.

<sup>1</sup> From the Department of Oral Surgery, the Carney Hospital.

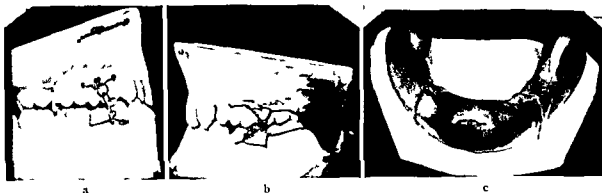


Fig 1 Methods of immobilization a Ivy method Eyelet wires around upper and lower premolar teeth Separate intermaxillary wire connects upper and lower loops b The Gilmer method No. 1 Single wires attached

#### TREATMENT OF MANDIBULAR FRACTURES

The method of treatment has for its object the overcoming of muscular pull with restoration of parts to normal or at least functional position. If teeth are present, this can best be attained by establishing the occlusion that was present before the fracture occurred and is most easily accomplished by wiring the upper to the lower jaw. In the care of fractures of the jaws, because of the presence of teeth, one is faced with conditions quite different from those encountered in fracture of other bones. Since immobilization is entirely a problem in the mechanics of dentistry, it is but natural that, from the hands of the dental profession with its great mechanical ingenuity, the various devices for fixation of fractured jaws should originate. Most means of intermaxillary wiring used today are but modifications of the first and second methods employed by the late

Dr. Thomas L. Gilmer (5) of Chicago, who was the first to advocate fixation of the upper to the lower jaw in the treatment of fracture of the mandible utilizing the teeth as anchorage. The first method (Fig 1, b) used by him consisted in placing a wire about the neck of a tooth and twisting the ends together. This was done on two upper adjoining teeth, as for example the two molars and likewise on the occluding lowers. The wires attached to the upper teeth were crisscrossed and twisted to those of the lower while normal occlusion was being established. This method had the disadvantage that it was not possible to separate the jaws should it be necessary without the possibility of destroying the whole wiring arrangement. The first method has various modifications today. Probably the most commonly used is the twisting of single upper and lower wires together. The eyelet method used by Ivy has the advantage that the jaws can be opened without interference with the main wires. Kazanjian (7) recommends the use of single wires the ends of which are twisted into knob-like projections which serve as anchorage for elastics.

The other method used by Gilmer consisted in the adapting of metal bars which acted as splints to the labial and buccal surfaces of both upper and lower teeth and holding them in place by small wires passed around the necks of the teeth. The upper arch was connected to the lower by means of fine intermaxillary tie wires. This manner of fixation was particularly applicable to those cases in which only a few teeth were present in each jaw. The Gilmer splint which had a wide range of usefulness has been further modified by Winter. Metal projections or lugs are distributed along the arch in such a manner as to afford convenient attachment for intermaxillary wires and



Fig 2 Unilateral fracture of maxilla Reduced and stabilized by arch attached to teeth

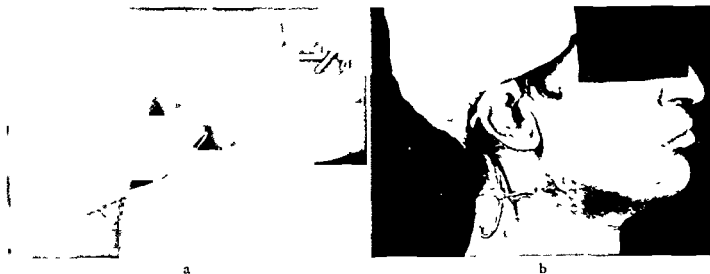


Fig 3 a, Fracture of mandible at angle with ramus in elevated position. Gradual reduction brought about by exposing the angle and drilling a hole through which brass

wire is passed. b, Immobilization completed. Wire from angle is connected by elastics to a heavy metal bar attached to plaster of Paris head cap.

are especially suitable where elastic traction is used, as in gradual reduction of badly displaced or late treated cases.

In the treatment of fracture of an edentulous mandible an entirely different problem is presented. Though accurate replacement of the fractured parts is not as essential as when teeth are present, since occlusion can be established later by artificial means, nevertheless union can result only if immobility of the bones is obtained. This may be brought about in various ways. Special splints which are joined together may be constructed to fit the upper and lower jaws. These are placed in position in the mouth and, by means of an external bandage supplemented

by elastics, reduction can be readily obtained. If the patient wears dentures they may be used instead and will accomplish the same purpose. A very efficient and practical manner of reduction is the circumferential wiring method (Fig 1, c) which was first employed by G. V. Black. An impression of the jaw is taken and from this a cast is made, a splint of either vulcanite or metal is then constructed. The splint fits the fractured mandible closely and is retained in place by wires inserted through skin incisions at the inferior border of the jaw. The wires are well tolerated by the tissues and are removed in about 5 weeks.

**Bandages.** Any bandage including the Barton and four tail is contra-indicated in the treatment



Fig 4 a, Roentgenogram of fractured edentulous mandible with extensive displacement. b, Reduction and

immobilization by means of the circumferential method of wiring.





Fig 5



Fig 6a



Fig 6b

Fig 5 Fracture of vertical ramus and malar bone. Reduction and immobilization accomplished by means of intermaxillary wiring.

Fig 6 a Fracture of neck of condyle with rotation of

the head in forward position. b Deviation of chin toward affected side corrected by elastic traction thus restoring both the former occlusion of teeth and the normal contour of face.

of jaw fractures, except when combined with elastics as a supplementary measure to some other form of fixation. As a rule, a bandage not only fails to hold the fractured parts in place because of its tendency to loosen but actually increases displacement. This is particularly true when backward pressure is exerted on the chin, causing overriding of the fragments and thus producing deformity. As a temporary aid a modified form of the Barton can be employed in which pressure is exerted upward in order to hold the mandible against the upper jaw.

#### CONDYLOID FRACTURES

Fracture of the neck of the condyle is due to indirect force usually from a blow in the region of the symphysis of the mandible. It is frequently seen as a result of automobile accidents being caused by the striking of the chin on the steering wheel. The fracture may vary from a subperiosteal type with no change in the normal relation of the fragments to a complete fracture of the neck of the process with displacement of the head inward and forward due to the pull of the external pterygoid muscle (Fig 6, a). The most characteristic symptom of fracture with displacement of the condyle is deviation of the chin toward the affected side with shortening of the ramus on the same side. The subjective symptom rather constantly present is pain when movement of the mandible is attempted or pressure applied anterior to the external auditory meatus.

Treatment consists of immobilization of the upper and lower jaws in normal occlusion. If deviation of the chin to one side is marked or the case a late treated one then gradual reduction can be brought about by elastic traction (Fig 6 b). In the light of the consistently good results

obtained by this method, one is surprised to find in the literature of the past few years, articles dealing with treatment by means of open reduction and mobility of the joint. These newer methods as to treatment not only seem unnecessary but are fraught with danger. Moreover, surgical manipulation of the head of the condyle into its proper anatomical position in the glenoid cavity is most difficult, producing rather disappointing results (8). In years past before the x ray became the important adjunct to clinical diagnosis that it is today, doubtless many successfully treated mandibular fractures were accompanied by involvement of the condyle which escaped notice. These fractures are usually of the closed type and open reduction, either intra orally or extra orally with the attendant complications which accompany compound fractures, plus the possibility of injuring the seventh nerve and thus risking a facial paralysis, seems unwarranted. To quote Ivy: 'We have successfully treated all cases, with or without displacement of the head of the condyle where it was possible to restore immediately the normal occlusion of the teeth, by fastening the upper and lower teeth together in occlusion from 3 to 5 weeks and have never seen a case result in ankylosis.' What position the condyle occupies after union has occurred is of interest only from an academic standpoint. Cryer, many years ago in his studies of the jaw bones, found mandibles in which good osseous union had occurred though the fractured condyle was in an abnormal position. The authors have observed a number of cases several months after the immobilization devices have been discarded and have noticed that the head of the condyle did not return to its former position, good functional and cosmetic results had always been obtained, however

### MALAR AND NASAL FRACTURES

Though not in a true sense belonging to the subject of this paper but due to the anatomical relation of the malar and nasal bones to the jaws, consideration is given to fracture involving them. Quite frequently maxillary and mandibular fractures are accompanied by injury to the bones of the zygomatic arch and nose. Undoubtedly because of lack of proper diagnosis many of these cases go untreated. Good roentgenograms are necessary as it is not always possible clinically to determine the extent of injury. Malar fractures as a rule are due to direct violence and unless edema is present, are characterized by flatness of the affected side. Simple fractures of the nasal bones or zygomatic arch are treated by placing the parts in as near normal position as possible. In most cases no special means of retention is necessary.

### POSTOPERATIVE CARE

If the best results are to be obtained, proper attention to the diet and hygiene of the mouth is necessary. The oral cavity should be frequently subjected to thorough prophylaxis and antiseptic mouth washes used daily. The diet should be carefully supervised in order to provide sufficient nourishment, which, of course, due to the absence of the function of mastication, must of necessity be of a liquid and semi solid nature. Soups, finely chopped meat, and milk are foods which possess high nutrient value and are easily assimilated. As a rule patients at first lose weight, but when the diet is well chosen they soon regain it.

### NON-UNION

Non union of fractures of the lower jaw is rare. (1) Failure of the parts to unite can usually be attributed to delayed or improper immobilization, especially if extensive displacement exists, suppuration due to retention of roots or infected teeth in the line of fracture, and loss of bone because of necrosis or as a direct result of the injury, as is commonly seen in gunshot wounds. Of the systemic diseases which are the common factors in delaying osteogenesis, syphilis is the most important. Because most fractures of the body of the mandible are compound, infection resulting in osteomyelitis is not infrequent. The establishment of adequate drainage and removal of sequestra when indicated is followed by union, though usually delayed. (4) Suppuration frequently continues long after the parts have united.

### TREATMENT OF NON-UNION

Those cases of non union due to the interposition of soft tissue between the ends of the

bone and infection with sequestration, can best be treated by directing attention to the causative agent. However, permanent non union with loss of bone can be successfully handled only by means of bone grafting. Depending on the extent of the gap to be filled, an osteoperiosteal graft from the anterior internal aspect of the tibia or a section of bone taken from the crest of the ilium is used. Success in bone grafting to the mandible is attained only when proper attention is given to certain fundamentals. It is necessary that all suppuration should have ceased, that fixation of the mandibular fragments in proper position should previously have been accomplished, and that entrance to the oral cavity be avoided at the time of operation. The graft is inserted through an incision made below the inferior border of the jaw, the site previously having been prepared by the removal of all cicatricial tissue and freshening the ends of the bone. Immobilization should be continued for at least 10 weeks.

### SUMMARY

1 Fracture of the bones of the face is of quite frequent occurrence. Maxillary and mandibular fractures are often accompanied by injury to the malar and nasal bones.

2 Reduction and fixation of fractures of the jaws should be accomplished always with a view to restoration of the normal occlusion of the teeth.

3 Good functional and cosmetic results can be obtained in the treatment of fractures of the condyle without resorting to surgical intervention.

4 The x-ray as an adjunct to clinical diagnosis is of inestimable value. A complete roentgenographic survey should be made in all mandibular fractures.

5 The hygiene of the mouth should be properly attended to. Any suppurative areas should be incised and drainage established.

6 Non-union of fracture of the mandible with loss of bone is best treated by employing grafts from the tibia or crest of the ilium.

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# AN OMENTAL FLAP IN TRANSPERITONEAL REPAIR OF RECURRING VESICOVAGINAL FISTULAS

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THE comparative ease of performance and the successful result which followed transperitoneal repair of a recurring vesicovaginal fistula, making use of an omental flap, has led to its use in a recent, more difficult case in which two vesicovaginal fistulas were present. In both cases the patients had been operated on several times previously elsewhere. Only a brief abstract will be given of the first case, as it was reported in the *Proceedings of the Staff Meetings of The Mayo Clinic* of June 12, 1935.

The presence of a linen thread inserted through the urethra and through the fistula during cystoscopic examination assisted in locating the fistulous opening. The openings in the vagina and bladder were closed separately. In order to prevent these two suture lines from being in apposition a portion of gastrosplenic omentum was brought down and sutured between the bladder and vagina. The postoperative ventral hernia was also repaired by the overlapping closure method of Mayo. A de L'etzer catheter was inserted temporarily through the urethra into the bladder, it was removed on the twentieth postoperative day. Primary healing of the fistula occurred.

The second case was that of a woman aged 50 years. In March 1934 she had undergone hysterectomy elsewhere.

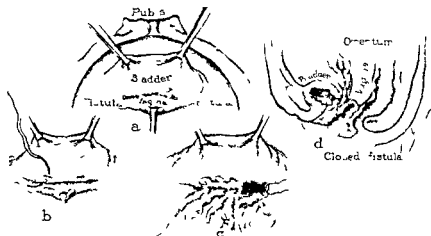


Fig 1 Transperitoneal repair of recurring vesicovaginal fistulas a separation of vagina from bladder b closure of fistulous openings c and d omental flap brought down and sutured between bladder and vagina

The patient in the first case was a woman aged 44 years. Her cervix had been amputated elsewhere in 1927 for chronic cervicitis. Abdominal hysterectomy had been carried out later also elsewhere. Four days subsequent to hysterectomy urine made its appearance in the vagina. Cystoscopic examination at the clinic in 1928 revealed that neither ureter was involved. There was a large postoperative ventral hernia, the fistulous opening was approximately 0.5 centimeter in diameter. After dissecting the vaginal wall from the bladder the fistulous openings were closed. The operation was difficult because of the inaccessibility of the tract. Following operation the fistula appeared to have healed, but after the patient had returned home it recurred. The patient then returned to the clinic in April 1935, requesting that if possible the postoperative ventral hernia be repaired at the same time the fistula was closed. Because of this the abdominal transperitoneal approach was used. The bladder was dissected from the vagina quite readily.

which had been followed by leakage of urine into the vagina. Several unsuccessful attempts had been made to repair this vesicovaginal fistula. On cystoscopic examination at the clinic two fistulous openings, each 1 centimeter in diameter, were found between the bladder and vagina. Because of the absence of the uterus the inaccessibility of the fistulas to a vaginal approach and the fact that they were multiple, transperitoneal approach was decided on. Here again separation of the vagina from the bladder was accomplished easily (Fig 1a), the location of the fistulous openings being marked by two linen threads extending from the urethra through the fistulas. After closure of the fistulous openings in the bladder and in the vagina (Fig 1b) an omental flap was brought down and sutured so that it lay between these structures (Fig 1c and d). The bladder was opened and a ureteral catheter was passed up each ureter to be certain that neither ureter had been encroached on in the closure of the vesical fistulous openings. Primary healing occurred with no urinary leakage at any time.

Division of Surgery The Mayo Clinic

Recent reports received from each of these patients indicate that they have obtained a satisfactory result

The transperitoneal repair of vesicovaginal fistula has rarely been employed. The ease with which this procedure was carried out in 2 cases, and the successful outcome from use of an interposing omental flap, is worthy of emphasis. It would appear that such a method might be applied successfully in the treatment of a large number of vesicovaginal fistulas which have heretofore been thought to be inoperable and for which urethral transplantation to the sigmoid was carried out.

It was surprising how easily the vagina and bladder could be separated and their walls mobilized for a sufficient distance from the fistula to close accurately and without tension the opening in each. The mobilization of these two structures was far better than I have usually been able to secure through the vaginal approach to a vesicovaginal fistula. In addition, the method gives one an opportunity to open the bladder if one wishes

to insert urethral catheters, so that in closing the opening, encroachment of one or the other or both of them will not occur. Of great importance, I believe, is the omental flap which is sutured between the vagina and bladder, this prevents the sutured openings from coming in contact and at the same time acts as a patch over each.

In a previous case, suture of omentum into a large chronic duodenal fistulous opening, which was followed by primary healing, suggested the use of this method for the transperitoneal repair of vesicovaginal fistulas. The brawny induration of the edges of the duodenum about the fistulous opening in this case made good approximation impossible, so omentum was used to suture *en masse* into the opening and primary healing occurred.

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# A SIMPLIFIED APPROACH FOR THE SUTURE OF ACUTE PERFORATION OF PEPTIC ULCER<sup>1</sup>

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**F**OR the past 3 years I have employed the incision herein described for the suture of acute perforations of peptic ulcer. I have found that it simplifies and shortens the operation considerably. It gives as much exposure as one needs for simple suture of the perforation. It is so placed that in the event of infection of the wound danger of subsequent herniation is negligible.

The technique is described in detail in the accompanying sketches. It will be noted that after the posterior sheath and peritoneum have been incised, the anterior surface of the liver is the only viscus exposed. The pylorus and duodenum come into view only after the liver has been retracted upward and to the right. No gauze pads are used. An Allis or Babcock intestinal clamp should be applied lightly to the first portion of gut which comes into the wound. With light traction on the intestinal clamp the site of perforation is usually visualized without difficulty. The perforation is closed over with four or five interrupted

From the Surgical Service of the Roosevelt Hospital.

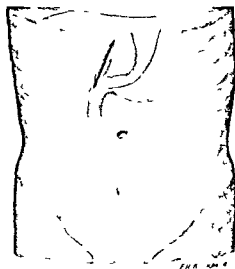


Fig. 1. The incision begins at a point 1 inch below and to the right of the tip of the costal cartilage. It extends downward and to the right 1 inch below and parallel to the costal margin. Its relation to the liver edge and the pylorus is shown diagrammatically. A length of 3½ inches is usually sufficient.

mattress sutures of linen applied in the direction of the long axis of the intestine. The closure of the perforation may be reinforced with a small tab of omentum, if any be available. The wound is closed in layers with interrupted or continuous sutures of chromic catgut, interrupted sutures of silk being used in the skin. A small rubber tissue drain, extending down to the anterior sheath, is inserted so that it emerges at the lower angle of the wound.

I should like to emphasize that I believe firmly that adequate exposure through an adequate incision is one of the primary requisites of good surgery, particularly of the abdomen. I use this incision because I find it adequate for its purpose and because I feel that its location and its design provide many advantages over the usual right rectus approach. Among its advantages are the following:

- 1 Straining under anesthesia will not interfere with exposure of the operative field nor will it interfere with subsequent closure of the wound.

- 2 The incision is easier to make, minimizes bleeding and shortens the operating time considerably.

- 3 Trauma to the viscera is reduced to a minimum. This feature is decidedly important in the prevention of postoperative adhesions, particularly in the presence of a potentially infected peritoneum. The advantage of dispensing with the use of gauze pads is obvious. The possibility of later surgery in some of these cases makes it imperative that we avoid any form of trauma which might promote the formation of adhesions in the upper abdomen.

- 4 The incision is made over the portion of the postpyloric area in which over 95 per cent of perforations are found. In many cases, upon retracting the edge of the liver the perforation comes into view without further search.

- 5 The entire deep surface of the wound is shielded against rupture by the presence of the liver. One of these wounds which broke down completely as a result of infection healed solidly without any evidence of herniation.

- 6 The incision may be extended downward with very little difficulty if a gall bladder or

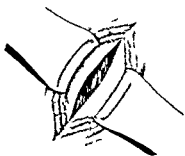


Fig 2

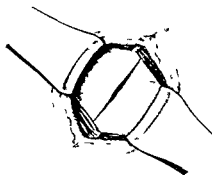


Fig 3

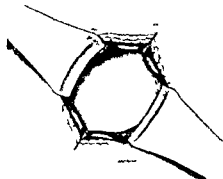


Fig 4

Fig 2 The anterior rectus sheath is divided in the line of the skin incision. The cut edges of the anterior rectus sheath are stripped back from the underlying rectus muscle.

Fig 3 The rectus muscle is split in the direction of its fibers, and retracted. The posterior rectus sheath and the peritoneum are incised diagonally in the line of the skin incision.

Fig 4 Retraction of the posterior sheath and peritoneum brings the free edge of the liver into view.

Fig 5 A tongue blade retractor is hooked around the free edge of the liver and pulled upward and to the right, thus exposing the pylorus and first portion of the duodenum. Light traction on this segment with an Allis clamp brings the perforation into view. A simple closure of the perforation is then performed.

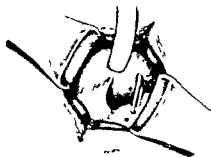


Fig 5

pancreatic lesion is found unexpectedly, or if the surgeon elects to do more than a simple closure of the perforation.

7 If an error in diagnosis has been made and the existing pathology is in the lower abdomen, the wound may be closed without any appreciable loss of time and a more suitable lower abdominal incision may be made. In the past, I have found that attempts to deal with a lower abdominal inflammatory lesion through the usual extended right rectus incision have been very unsatisfactory and, in some infected cases, have resulted in severe crippling of the right rectus muscle. It is quite true that ordinarily a very long incision, properly sutured, is not much more disabling than a shorter one. However, in the presence of a potentially infected wound, the risk of subsequent incisional hernia is too great to be ignored.

8 Our patients have complained of surprisingly little wound pain after this procedure. Some have shown no voluntary inhibition whatsoever of the cough reflex. This is in decided contrast to the

agonizing pains suffered in coughing by the patient with a long fresh right rectus wound. The relationship between wound pain, the cough reflex, and postoperative pulmonary complications is, in my opinion, a very definite one.

9 The patient may be allowed out of bed much sooner than is permissible with the usual right rectus wound. However, in the presence of a freshly sutured active ulcer, bed rest for a full 2 weeks may be desirable.

This incision has now been used in 21 cases on our service. In 2 instances, an extension downward for a distance of several inches had to be made. In one case, there were a great many dense adhesions obscuring the site of perforation. In the other case, the perforation was found at the center of a large indurated ulcer, high up on the lesser curvature of the stomach. Enlargement of the incision was necessary to permit exploration for diagnosis, carcinoma at first being suspected. In the remaining cases the exposure was quite gratifying.

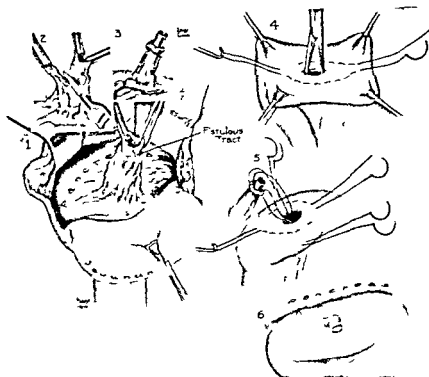


Fig 1 Steps used in pancreatojejunostomy 1. Fistulous tract to the pancreas cored out from the abdominal wall. Note the defect remaining on the right side of the incision where the fistulous tract was cored out. The jejunum has been brought up over the transverse colon preparatory to implanting the fistulous tract in it. 2. Paring the thick wall of the fistulous tract down to its base. In doing this special care must be exercised lest the walls of the tract be pared too thin, perforated and the tract spoiled. 3. The prepared fistulous tract with a short section of catheter tied into it so that the pursestring suture by which it is to be buried into the jejunum will not occlude it. Note the cuff of scar tissue left at the base of the tract to be attached to the jejunum to prevent the bowel pulling away while the fistula is healing into the jejunum. 4. The method of preparing the opening into the jejunum for the implantation. The best opening with the least bleeding is made by forcing a closed sharp pointed gaster hemostat through the jejunum after the pursestring suture has been inserted and with the jejunum held in intestinal forceps. As shown in the illustration this opening with little or no bleeding can be dilated by the forceps to any size desired. 5. Two silk sutures which catch the end of the fistulous tract, are passed into the opening in the jejunum and out close to the mesentery. These traction sutures make it possible to guide the tract into the jejunum, even then not an easy procedure. With the tract well inserted into the jejunum the pursestring suture is tied snugly about the neck of the fistula since with the tube in it, obstruction will not result. The fine silk guide sutures emerging through the wall of the jejunum are now cut and withdrawn. 6. The cuff of scar tissue left at the base of the fistulous tract and shown in 3 is now fixed to the wall of the jejunum by interrupted silk sutures front and back to prevent escape of the fistulous tract from the bowel and the operation is completed.

*Cure of Pancreatic Fistula by Pancreatojejunostomy—Frank H. Lahey and Rolf Lism*

# CURE OF PANCREATIC FISTULA BY PANCREATO-JEJUNOSTOMY

## Report of a Case with Review of the Literature

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THE treatment of pancreatic fistula has received considerable attention in the European literature in the past and several excellent reviews have been written (7, 11, 42, 58). However, we have been unable to find a discussion of this subject in the American literature and therefore believe it worth while to report the following case and summarize the various methods of treating the condition.

The patient was an 18 year old white, single, native, unemployed male who was kicked in the abdomen while playing football on October 16, 1935. Three hours later he began to complain of severe pain across the upper abdomen, became nauseated and vomited. He was given two hypodermic injections of morphine which enabled him to pass a comfortable night. On the following day he felt well until afternoon when he again vomited. On the second morning after the accident he again suffered with severe epigastric pain, and was taken to the Eastern Maine General Hospital where an abdominal exploration was done. The report from this hospital states that a small right upper quadrant incision revealed a hemorrhage into the gastroduodenal omentum probably originating from a traumatic rupture of the pancreas, although the pancreas was not visualized. A drain was inserted and the abdomen was closed. Immediately after operation a copious drainage of pancreatic juice began and continued until the patient left the hospital on December 5, 1935, 7 weeks after the accident. At this time there was no external secretion, but on the following day the fistula reopened. There were several episodes when the sinus closed only to be promptly followed by epigastric pain, nausea and vomiting and epigastric swelling. These symptoms were immediately relieved when the fistula was reopened and after each reopening a copious discharge of fluid followed.

On December 30, 1935, an x-ray study of the sinus revealed a cavity to the right of the midline and about half way between the anterior abdominal wall and spine which was about  $\frac{3}{4}$  inches in oblique and 2 inches in vertical diameter.

The patient was admitted to the Clinic on January 22, 1936 3 months after the original accident. Physical examination disclosed a well developed and nourished young man with moderate pallor. The abdominal incision was well healed and in the upper third showed a fistulous opening which was discharging clear, opalescent fluid. The surrounding skin was not macerated but had been protected by applications of tannic acid powder. A catheter was inserted into the sinus tract, held firm by adhesive tape, and was then led into a bottle suspended from the patient's belt so that all of the fluid could be saved and measured. This proved a quite adequate method for avoiding leakage and protecting the surrounding skin (Fig. 8).

X-ray studies with injected lipiodol and sodium iodide demonstrated the cystic cavity to be about one fifth the size originally determined, and in view of such a reduction in size within a 3 week period of time we decided to pursue a conservative course of treatment. The young man was admitted to the New England Deaconess Hospital where various studies were done, the results of which are here recorded.

1 The stools showed apparently normal fat and protein digestion.

2 The secretion of pancreatic juice was constant. It was the least in amount at night and rose to higher levels after food was taken (see chart, Fig. 5). It was frequently increased temporarily after water was drunk. Acid administered by nasal tube stimulated the pancreas markedly.

3 Amount of pancreatic juice, 332 to 663 cubic centimeters a day, specific gravity 1.011 to 1.0135, total solids, 0.0113 to 0.0124 grams in 1 cubic centimeter, alkalinity, 3.5 to 5 cubic centimeters,  $\frac{1}{10}$  normal hydrochloric acid necessary to neutralize 10 cubic centimeters pancreatic juice, non protein nitrogen, 7.14 to 11.76 milligrams per cent, total nitrogen, 60.60 to 71.9 milligrams per cent total protein, 324 to 376 milligrams per cent, glucose tolerance test showed a normal reaction.

4 Lipase and amylase were present in active form in fresh specimens, but trypsin was not although it was demonstrated by the addition of enterokinase from freshly killed hog's duodenum. Quantitative determinations of the enzymes were not done.

5 Dietary measures. When the patient was first admitted he was placed on a low carbohydrate (126 grams) diet which he disliked because it was unpalatable and left him feeling hungry. However we did have an opportunity to determine the efficacy of soda before changing his diet. On a low carbohydrate diet without soda the secretion was 663 cubic centimeters and with alkali powders ( $\text{NaHCO}_3$ , 30 grains,  $\text{CaCO}_3$ , 30 grains, every hour) 353 cubic centimeters in 24 hours.

In order to satisfy the demands of the patient the diet was increased to carbohydrates 328, proteins 102, fats 134 and this on 4 successive days elicited an average secretion of 552 cubic centimeters a day. The extremes were 468 cubic centimeters and 604 cubic centimeters. This same diet was then supplemented with 30 grains sodium bicarbonate and 30 grains calcium carbonate, every hour and atropine  $\frac{1}{150}$  grains by mouth three times a day and  $\frac{1}{100}$  grains by mouth at bedtime. The average secretion for 3 days was 387 cubic centimeters or a diminution of 165 cubic centimeters a day. The extremes were 359 cubic centimeters and 411 cubic centimeters. The atropine was then increased to  $\frac{1}{150}$  grains every 2½ hours and the pancreatic juice also referred to the patient. These additional measures did not prove helpful, for the average secretion, during the 2 days this was done, remained 393 cubic centimeters, the extremes being 332 and 455 cubic centimeters on the same diet. Atropine in large doses sufficient to cause



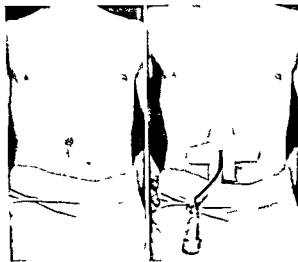


Fig 2 left A photograph of the fistulous opening in the scar of the previous operation

Fig 1 The method of inserting and retaining a catheter in the fistulous tract thus protecting the wound and preserving the pancreatic secretion for measurement or ingestion

symptoms of tachycardia, dryness and visual disturbances had no demonstrable effect of importance so far as could be determined and refeeding the pancreatic juice was of little benefit. The administration of soda did prove to be of definite value. Our studies were not conclusive in regard to dietary measures but suggested that there was little difference between a low and high carbohydrate diet—a supposition which later was shown to be erroneous.

When the patient left the hospital the sinus had shrunk to the size of the infusing catheter as shown by x-ray studies. The patient was instructed to take a liberal diet and to use the alkali powders as he had done in the hospital. On this regimen the secretion averaged 4.4 cubic centimeters a day for 8 days, the extremes being 410 and 570 cubic centimeters. He was now asked to continue the powders and attempt to take as much fat as possible and to avoid carbohydrate foods over a 7 day period. The average secretion fell to 384 cubic centimeters a day, or 90 cubic centimeters less than the previous amount. The extremes were 320 to 412 cubic centimeters. These figures are based on rough dietary measures at best but they do suggest a definite reduction in pancreatic secretion on a high fat—low carbohydrate as contrasted with a liberal mixed diet.

In spite of the moderate diminutions in secretion there was no progressive cessation of the flow of pancreatic juice and once any measure was established the amount of secretion assumed a level and remained there. This plus the desire of the patient to be rid of the fistula plus the previous history of closure elsewhere followed by epigastric tumor, pain and vomiting decided us in favor of transplantation of the fistula into the jejunum.

During the 3 weeks preceding operation the fistula was gradually dilated from a size 14 to size 22 French catheter. On March 16, 1936, 5 months after the original accident a pancreatojejunostomy was done by one of us (Lahey). At that time the following operative note was made and the procedure sketched at the operating table by the artist (Fig 1). Under spinal anesthesia an incision was made around the fistulous tract and the peritoneal cavity entered

about 2 inches below the opening of the sinus. All layers were dissected through the peritoneum first to the left and then to the right of the fistula from below. The fistulous tract passed between the stomach and the transverse colon and was well surrounded by omentum. It was dissected back toward its base about 2 inches and coiled away until it was only about  $\frac{1}{2}$  inch in diameter. A size 22 French catheter was tied into the sinus with silk to prevent occlusion of the canal following its implantation. A loop of jejunum was brought up and with a Babcock clamp on each corner of a rectangular area opposite the mesentery, a straight clamp was punctured through the wall of the jejunum. The blades of the clamp were separated, the opening dilated and a pursestring suture placed around this opening and left free. Two silk stitches were placed, one on either side of the end of the fistula. These stitches were then brought through the wall of the jejunum as shown in the illustration and were used to draw the fistula into the jejunum. This maneuver was executed with considerable difficulty. The pursestring suture was then tied and a row of interrupted catgut sutures placed between the omental neck of the fistulous tract and the jejunum. Finally a continuous suture was placed between the omentum and jejunum. At the end of the operation the fistulous opening could be felt well within the jejunum and there was no encroachment upon the lumen of the jejunum. The abdomen was closed with interrupted silk through and through sutures without a drain.

The postoperative convalescence was uneventful except for very slight wound sepsis which had cleared up entirely by the twelfth day after operation. The patient left the hospital on the seventeenth day after operation apparently in good health and the wound in good condition and has remained well and free from any symptoms.<sup>1</sup>

#### REVIEW OF THE LITERATURE

Pancreatic fistulas may be divided into those of such magnitude that they do, and those that do not, interfere with digestion and nutrition. The former are uncommon but deserve special mention because of their danger to life. McCaughan has shown that in dogs a complete external pancreatic fistula causes death within 5 to 8 days. Anorexia, irritability, and loss of weight are the outstanding symptoms, and great relief is manifested when the juice is re-fed by mouth.

This work has definite clinical confirmation. One of us (R. L. 59) observed a case in which Wirsung's duct was intubated for 11 days. The symptoms of anorexia, weight loss, and irritability were prominent until the tube was removed, re-establishing the continuity between pancreas and duodenum, when symptomatic improvement followed. Garis and Meckel report a similar train of symptoms in a case with carcinoma of Vater's

<sup>1</sup>Since this paper was sent in for publication the patient has returned again for treatment. On August 13, 1936, while playing baseball, he fell on his back. He was afterward seized with a cramp-like pain in the abdomen, vomited a few times, had a rigid abdomen and pain radiating into the right lower quadrant. This occurred in Maine at his home where he was seen by the local surgeon. A diagnosis of question of rupture of the pancreatic fistula was made. The abdomen was explored on August 21, and the pancreatic fistula remained intact. He recovered uneventfully from the exploration with no ill results. The transplanted pancreatic fistula which was functioning most satisfactorily is of interest to submit in the future this patient's already eventful record.

ampulla in which there was a biliary and pancreatic fistula with fatal outcome

In the case of Cathala and Senegre the patient's weight decreased from 80 to 58 kilograms in 4 months but was increased by 11 kilograms in 2 weeks when the pancreatic juice was re-fed. Copello reports an almost miraculous change in his patient, who was rapidly failing, brought about by drinking pancreatic juice. Von Friedrich describes a case with weight loss, and with fat and undigested meat fibers in the stools. The fistula closed spontaneously and the patient immediately felt better and began to gain weight. Kleinschmidt, in his case of total fistula, noted a weight loss of 15 kilograms in 3 months, fatty stools, and general debility, all of which symptoms were relieved by transplantation of the tract into the jejunum 3 months after onset. Kroiss' patient secreted 1 liter a day and lost weight and strength until a high carbohydrate low fat diet was supplemented with ereptone by rectum and mouth. With this treatment a definite improvement was noted, the patient gained weight, and the fistula closed in 3 weeks.

From these experiences it would seem that the conservative measures of greatest use in treating the larger pancreatic fistulas are (1) ingestion of the pancreatic juice by mouth, (2) a high carbohydrate, low fat, diet supplemented by ereptone given orally and rectally. The rationale of such a dietary regimen as outlined by Kroiss is that fat and protein are poorly handled in total pancreatic fistula whereas carbohydrate is easily assimilated. Ereptone supplies the end products of protein digestion, and carbohydrates being easily absorbed are given in liberal amounts, but fat is excluded. The chief purpose here is to sustain the patient's general condition and hence the dietary measures are quite different from those advocated for partial fistulas.

If the fistula fails to close with this type of treatment a transplantation should be considered. (41) Kleinschmidt recommends early transplantation, but that one should not be too hasty is shown by the case of von Friedrich. His patient lost weight and strength and had undigested fat and meat in his stools. Nevertheless the fistula closed spontaneously.

#### TREATMENT OF PARTIAL FISTULAS

Under this heading are included those cases in which there is present an active fistula which does not interfere with digestion or the general nutritional state of the patient. There have been many methods suggested for the conservative treatment of these cases.

*A Local measures* These consist of applying caustic agents to the opening to facilitate closure. This method has been tried by a number of authors without notable success. Kleinschmidt applied copper sulphate and zinc sulphate to the fistulous tract by means of a catheter without benefit. Harnes (25) objected to his results from the use of cautery in that drainage was impaired. Bazy used tincture of iodine to the cutaneous orifice without benefit. Although such local treatment may at times meet with success the results have not been very gratifying.

*B Measures lessening secretion* Wohl-gemuth regimen. In 1907 Wohl-gemuth (65) conducted a series of experiments on a patient with pancreatic fistula and concluded that the human pancreas is stimulated most by a carbohydrate meal, less by protein, and least by fat. He also determined that acid is a powerful stimulus to the pancreas whereas soda acts as an inhibitor. These findings were confirmed later by Holst.

On the basis of these physiological facts Wohl-gemuth recommended the regimen which now bears his name. It consists of a strict low carbohydrate diet which not only excludes pure starches and sugars but also foods such as potato, bread, and derivatives of flour which contain large amounts of carbohydrate in combination with protein. Adequate calories are supplied by proteins and fats, and sodium bicarbonate is administered in 4 gram doses  $\frac{1}{2}$  hour before and after meals. Wohl-gemuth recommends an adherence to this regimen for 6 weeks, but if at the end of this period the secretion has not lessened, the regimen can be considered to have failed.

By this method Wohl-gemuth succeeded in closing his patient's fistula in a few days. A second paper (66) reviews 3 cases by other authors, Heineke, Koenig, and Schmidt in which his therapy met with success.

Kroiss, in a critical review of Wohl-gemuth's data, concludes that the regimen is of little value, that in the cases cited in support of the regimen one finds inconclusive data. In Wohl-gemuth's own case (reported by Koenig and Hohmeier) the diet was begun  $\frac{1}{2}$  year after the fistula originated and the fistula closed within 10 days. Severe epigastric pains followed and after 21 days the fistula reopened. With a resumption of the Wohl-gemuth regimen, closure followed in 14 days and remained permanent. Kroiss then cites his own case which was given a high carbohydrate diet and, despite a secretion of one liter a day, the fistula closed in 3 weeks.

Striking as have been many of the reported closures following the institution of Wohl-gemuth's

TABLE I—CASES IN THE LITERATURE OF TRANSPLANTED PANCREATIC FISTULAS

Author	Cause of Fistula	Duration	Amount	Medical Treatment	Operation	Result	Complications
1. Cathala and Seneque	Incision and drainage of a pseudocyst	5 mos		Carbohydrate lowered secretion but not enough for closure	Pancreato-gastrostomy	Good	Fistula tended to close. Pain wound introduced with relief. Intest lost from 80 to 50 kilograms. On pancreatic juice by mouth gained to 70 kilograms in 14 days.
2. Corachan	Drainage of cyst	1 yr			Pancreato-gastrostomy	Good	
3. C. Pello	Drainage of cyst	9 mos	250 c cm	Tried Wohlgermuth regimen 3 mos. Fistula closed but severe pains. Reopened.	Pancreato-gastrostomy	Good	
4. Courboules	Drainage of cyst	4 mos	500-900 c cm	Wohlgermuth regimen 5 days. Lowered secretion which remained level.	Pancreato-gastrostomy	Good	Patient lost weight and strength.
5. Demel	Drainage of cyst	9 mos			Pancreato-gastrostomy	Good	Fistula closed followed by pain and reopening.
6. Doyen	Not given				Pancreato-gastrostomy	Good	
7. Finsterer	Reaction to ulcer	3 mos	600-1200 c cm	Diets without benefit. No benefit of Wohlgermuth.	Pancreato-jejunostomy	2 yrs. Good	Died jejunostomy first and connected fistula to tube. Patient was losing strength before this and gained rapidly with this arrangement. Later transplantation.
8. Gutierrez	Drainage of cyst				Pancreato-gastrostomy	3 mos. Good	
9. Hahn	Acute pancreatitis drained	4 mos		Schmidt diet of no value.	Pancreato-jejunostomy	3 weeks. Good	Fistula closed. Cyst found. Opened. Fistula formed and transplanted.
10. Hamme-fahr	Excision of pancreatic cyst	2 yrs	Estimated at 3 to 4 liters a day.		Pancreato-cholecystostomy	7 mos. Good	General nutrition poor before operation.
11. Harries	Drainage of pseudocyst	5 m			Pancreato-gastrostomy	Good. Well and excellent.	
12. Hohibaum 13 14	3 cases after gastric resection for ulcer				3 cases of pancreato-jejunostomy	2 g. died 8 days later from pneumonia.	
15. Ingebrigtsen	Drainage of pseudocyst		830 c cm later 300 c cm	No benefit from Wohlgermuth regimen.	Pancreato-jejunostomy	Good	Closed spontaneously. Pain. Opened. Closed again. Pain and tumor. Opened and later transplanted.
16. Isards and Zanardo	Drainage of cyst	5 mos		Wohlgermuth regimen of no benefit.	Pancreato-gastrostomy	Good	
17. Jones	Drainage of acute pancreatitis	4 m	600 c cm later 300 c cm		Pancreato-gastrostomy	Good. No defect in stomach 3 wks. later.	Fistula closed. Cyst formed. Marsupialized. Fistula closed 3 times. Pain and vomiting resolved. Relieved by opening fistula.
18. Kehr	Not given				Pancreato-cholecystostomy followed by cholecyst gastrostomy	Good	
19. Klein-schmidt	Gastric resection				Pancreato-jejunostomy	Good	Patient had fatty stools. Lost 15 kilograms weight. Fistula closed. Relieved by pain and vomiting several times. Relieved by re-opening.
20. Konjetzny	Resection of ulcer	m	800 c cm	Wohlgermuth regimen with soda and atropine without benefit. X-ray of no value.	Pancreato-jejunostomy	3 m. Good	Excised fistula first. Returned. Closed. Pain and vomiting. Relieved from reopening. Transplanted.

TABLE I—CASES IN THE LITERATURE OF TRANSPLANTED PANCREATIC FISTULAS—Continued

Author	Cause of Fistula	Duration	Amount	Medical Treatment	Operation	Result	Complications
21 Madier	Gastric resection for ulcer of lesser curvature	7 mos	300 c cm	Wohlgemuth regimen of no value	Pancreatojejunostomy	Good 3 yrs	Fistula closed Pain tumor and fever Relieved by reopening
22 Madier	Drainage abscess of pancreas	4 mos		Wohlgemuth regimen and atropine of no avail	Pancreato-gastrostomy	Brief fistula after transplant 4 mos later well	
23 Michon	Drainage of cyst	3 yr	3-80 c cm	Wohlgemuth regimen of no value	Pancreato-gastrostomy	Good	
24 Marquot	Drainage of cyst			Without benefit	Pancreato-gastrostomy	First anastomosis broke down At 2nd operation placed tube in fistula at time of anastomosis Successful	
25 Polake	Resection of stomach for ulcer followed by cyst which was drained	3 yrs		Wohlgemuth regimen without benefit	Pancreato-gastrostomy	Good	Abscess in wound but this cleared

muth's diet, there have been many failures. Of 17 cases collected by Desvaux de Lyf 10 were benefited and 7 not. Since this latter summary there have been other cases reported in the literature, some favorable (5, 6, 15, 51, 62, 67), others not (13, 44, 32, 31, 47). Bazy found it of benefit in one case but of no value in another which later closed of its own accord. Koerte reported it to be of no value in 4 cases. Although von Friedrich noted that of the pure food stuffs, carbohydrates elicited the most pancreatic secretion the fistula closed in his case on a low fat, well mixed diet.

2 *Atropine* In 1924 Hartmann recommended the use of atropine as an adjunct in the closure of pancreatic fistulas. In his case a fistula developed after drainage of the pancreas for acute pancreatitis. Although the Wohlgemuth regimen was of little value the fistula closed at once after atropine was begun. Madier reported atropine to be of no value in his 2 cases, and Konjetzny (40), Cathala and Senegue, and Courboulès report a similar experience with this drug. Villard and Labry (58) noted only a very slight diminution in secretion when atropine was given.

3 *Ereptone* Ereptone by mouth and rectum was recommended by Kroiss as a method of sustaining the patient's general condition in total fistula and von Haberer felt that it was of benefit in sustaining his patient as well as lessening the secretion. Steindl and Mandel advise a combination of the Wohlgemuth regimen and ereptone therapy. This brought about a closure of their patient's fistula in 2 weeks but the 24 hour average was only slightly above 200 cubic centimeters.

4 *Claude Bernard's method of atrophy* Mention should be made of Claude Bernard's method of pancreatic atrophy. He found that a retrograde injection of olive oil into a pancreatic fistula causes the acinous elements supplying that duct to undergo atrophy. Michon tried this method briefly on his case and noted some diminution in lipolytic ferments. No atrophy resulted, but his experiment was not long enough to be conclusive.

In attempting to evaluate this literature one must remember that the majority of fistulas tend to heal spontaneously. Of 33 cases of pancreatic cyst drained by Judd (35) no fistula persisted over 2 years and most closed within 1 year. Desvaux de Lyf found that of 88 fistulas 78 were temporary and of these 62 closed within 1 year. One encounters such unusual cases as that of Koerte whose patient drained 500 cubic centimeters of pancreatic juice daily for 21 months and then suddenly ceased and remained closed without any treatment. Also that of Zahn who used the Wohlgemuth regimen for 6 days with apparent benefit and then ceased using it whereupon the fistula continued to close. A recent case reported by Kahn and Klein secreted approximately 1 liter a day, and on a liberal dietary regimen closed in 59 days.

It seems logical to assume that if any of these measures lessen secretion in any particular case they will facilitate closure by encouraging a bridge of granulation tissue to form across the sinus, but it is difficult to prove their efficacy because similar results are so frequently obtained both with and without treatment.

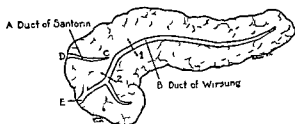


Fig 4 Diagram showing the two main ducts of the pancreas A duct of Santorini or lesser pancreatic duct B duct of Wirsung or greater pancreatic duct C is the point at which the two ducts may communicate D is the duodenal papilla of the duct of Santorini which may or may not be patent E is the ampulla of Vater 1 Represents the point at which a complete severance of the duct of Wirsung may lead to a non-closing pancreatic fistula 2 Point at which a complete severance of the duct of Wirsung may lead to a non-closing fistula providing there is no connection between the duct of Santorini and the duct of Wirsung at C or D is occluded

**Radiotherapy** The most quoted paper on radiotherapy of pancreatic fistula is that of Culler, but when one analyzes these cases the evidence is not convincing. His first patient had sustained a gunshot injury in which the bullet passed through the body. There was some necrosis of fatty tissue around the wound which ceased after x ray therapy in divided doses had been given for 5 days. The second patient had had a posterior gastro-enterostomy for cancer of the stomach. There followed a rupture of the wound with fat necrosis and discharge of some clear fluid which ceased after treatment which was similar to that given in the first case. In neither of these instances was there actually a fistula, and there is no mention of quantitative or qualitative studies of the juice secreted. Konjetzny used x ray therapy to the pancreas in a well established fistula without noticeable benefit.

Von Redwitz and Hamilton recommend the use of radium to the fistulous opening, but here again the facts scarcely justify this measure as a sound therapeutic method. In the former case a fistula followed the marsupialization of a cyst, but we are not given the daily volume of secretion. The secretion was gradually lessening and 2 months after the original operation 50 milligrams of radium was placed in the opening for  $\frac{3}{4}$  hour and 2 weeks later the fistula closed—a result frequently seen when no treatment is used. In Hamilton's case the fistula secreted 900 cubic centimeters a day and with repeated doses of radium it continued to secrete 600 cubic centimeters in 24 hours 1 month after treatment was begun. The fistula closed but closure was followed by severe epigastric pains, and the fistula finally opened

and discharged again. It then closed gradually and remained closed. From these facts one can only conclude that radiation therapy is of questionable value in closing pancreatic fistulas.

**Non-closing fistulas** Even though the sinus closes, the patient is cured only if the secretion can be diverted into the intestine through one of the pancreatic ducts, this is impossible in certain cases on theoretical grounds and as borne out by clinical experience.

We know that there are two pancreatic ducts in man, the greater, or duct of Wirsung, and the lesser, or duct of Santorini (Fig 4). These usually connect at C, but Baldwin found in 46 cases studied at autopsy that there was no connection in 6. In 5 cases of 46 examined, the lesser duct had no opening into the duodenum. Putting these two facts together Baldwin determined that in 22 per cent of cases, pancreatic juice cannot pass from the greater to the lesser duct, and in 13 per cent it cannot flow in the reverse direction.

If the pancreas is injured during operation, or by trauma, or through infection, so that the continuity of the duct is completely severed at 2 (Fig 4) a fistula need not form, or if it does form it need be only temporary, if duct A connects with duct B and the duodenal papilla of A is patent. But in 22 per cent of cases either one of these conditions is lacking and an external fistula not only must form, but its closure is problematical unless the part of the pancreas draining into it undergoes atrophy. In all cases with complete severance at 1 the same is true, and one can visualize other possibilities in which ducts are so injured that only a transplantation of the fistula will result in cure.

These theoretical considerations are well substantiated by a number of cases. Thus Ingebrigtsen, Madier (47) (same case as discussed by Villaret and Justin Besancon), Demel, Kleinschmidt, Janes, Copello, Cathala and Senecque, and Konjetzny report cases in which the fistula closed, followed by pain, epigastric tumor, and vomiting which symptoms were immediately relieved by reopening the fistula. All of these fistulas were persistent, necessitating transplantation. In 1 case (33) the fistula remained closed after one such episode of pain and vomiting. A cyst formed which was drained and later a pancreatogastrotomy was done. A similar case was reported by Hahn (21) a primary anastomosis being made here between the cyst and the jejunum. In Konjetzny's case the Wohlgenuth regimen, atropine, and x ray therapy, all failed to close the fistula and when the secretion lessened, pains followed which were at once relieved by dilating the sinus.

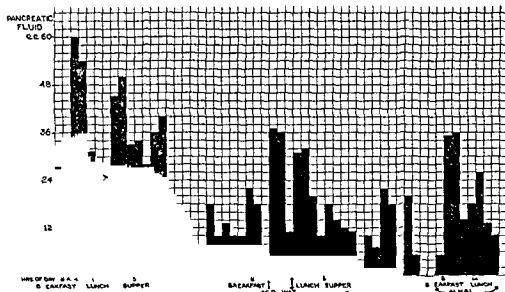


Fig 5 Chart of hourly secretion of pancreatic juice. Meals the same on all days except on the second when breakfast was omitted. Shows response of pancreas to water by mouth, and acid by stomach tube. The lowered response of the pancreas to food when alkali is given is also demonstrated.

Thus in a certain number of cases the damage to the pancreatic ducts is such that it is impossible for the secretion to reach the intestine except by transplantation of the fistulous tract.

From our review of the literature we believe that every patient with a partial fistula should be given a liberal trial of conservative therapy, but if this fails one should not hesitate to resort to surgery. That transplantation of these fistulas is a safe and successful procedure is borne out by a number of cases. We have found in the literature 25 cases of anastomosis between the gastro-intestinal tract and a pancreatic fistula. Of these, 14 were done as a pancreatogastrostomy, 9 as pancreatojejunostomy, 1 as a pancreatocholecystostomy, 1 as a pancreatocholecystostomy, followed by a cholecystgastrostomy. There was only 1 death in this series (Hohlbaum's case), death resulting on the eighth postoperative day from pneumonia, in all of the other cases uniformly excellent results are reported. Adding our case to this number of successful operations makes a total of 26 with a mortality of 3.8 per cent, thus establishing anastomosis as a relatively safe surgical procedure. One of the theoretical objections to anastomosis is the danger of retrograde infection leading to pancreatitis. That this is only apparent is shown by the uniformly excellent results.

**Excision of fistula.** This is a formidable procedure and often unsuccessful. Thus Konjetzny attempted excision of the fistula with re-establishment of the fistulous tract, and subsequent transplantation was necessary.

#### PREVENTION OF PANCREATIC FISTULAS

It is an impressive fact that most of the pancreatic fistulas originate in drainage of pancreatic cysts. Desvaux de Lyf found in his collected series of 113 cases of fistulas that 80 per cent originated as cysts which were drained. In our collected cases of transplanted fistulas 12, or 50 per cent, originated as cysts and 5 followed gastric resection. Since pancreatic cysts are such important factors in the development of subsequent fistulas, it does not seem amiss to consider possible improvement in the surgical approach to these conditions.

Of the 3 accepted methods of handling pancreatic cysts—excision, drainage, and anastomosis to the gastro-intestinal tract—drainage, as first recommended by Gussenbauer has been practiced most of all. In Judd's (35), (1931) series of 47 cases, 33 were marsupialized and drained and 7 excised *in toto*. Although the fistula following drainage of the cyst closed in most of the instances within a short period of time, Judd remarks about the fistula being a source of constant annoyance to the patient. Other cases of cyst excision have been reported (3, 4, 56, 63), but this procedure is frequently impossible and always associated with the danger of leakage and subsequent fistula formation. The mortality from this operation varies between 9.5 to 25 per cent if the cyst is removed successfully, but reaches 55.5 per cent if extirpation is attempted but fails (17).

We have been able to find 9 instances of primary anastomosis between a pancreatic cyst and the gastro-intestinal tract. These are summarized

TABLE II—PRIMARY ANASTOMOSIS BETWEEN  
PANCREATIC CYST AND GASTRO INTESTINAL  
TRACT

JEDLIČKA	Cyst excised duct found in operative field Duct anastomosed to posterior wall of stomach 5 year follow up Good result
WALZEL	Cyst anastomosed to gall bladder, cutting cystic duct Reasoned that pancreatic juice would be absorbed by gall bladder Reoperation 2 months later for adhesions showed the cyst shrunken in size and anastomosis intact
HARRIES (26)	Pancreatic cyst anastomosed to anterior wall of stomach
VECCHI	Anastomosed cyst to anterior wall of stomach
KERSCHNER	Cut through anterior wall of duodenum and then through posterior wall into the cyst The patient died 7 weeks later from pulmonary tuberculosis The cyst had shrunk from the size of a child's head to that of a walnut
JURASZ	Cysts anastomosed in 2 patients to the posterior wall of the stomach by incising anterior wall and then using cautery to enter the cyst through the posterior wall of the stomach One year and 8 months follow up respectively Both well
HARRIS (22)	Pancreatic cyst drained It drained for 1 month and then closed reforming a cyst Cyst anastomosed to jejunum Three years later the patient had spell of indigestion after a dietary indiscretion Was reoperated upon and the anastomosis was found in excellent condition 4 year follow up showed healthy patient
NEUFFER	Pancreatic cyst anastomosed to the gall bladder 4 weeks follow up Patient well
LORENZ	Pancreatic cyst excised Open duct of Wirsung found in bed of excised cyst Duct anastomosed to posterior wall of stomach Successful Drained pancreatic juice for 4 weeks Closed and wound well healed 5 months follow up Well
	10 cases no operative mortality
	Marsupialization resulted in 4 to 6 per cent mortality (52)
	Excision resulted in 9.5 to 25 per cent mortality (52)

briefly in Table II There was no operative mortality Kerschner's patient died, however, 7 weeks after the operation from pulmonary tuberculosis and at autopsy it was shown that the cystic cavity had shrunken in size from a child's head to that of a walnut That there is little danger of postoperative infection is shown by the cases of Jedlicka and Jurasz The former anastomosed a large pancreatic duct, which he found in the operative field after removing a pancreatic cyst to the posterior wall of the stomach and the patient was well 5 years later The latter author in both of his cases cut through the posterior wall of the stomach into the cystic cavity, and in neither of these was there any evidence of retrograde infection

We believe, therefore, that an important preventive measure in cases of pancreatic fistulas is the use of primary anastomosis whenever this is possible in the surgical treatment of pancreatic cysts The occurrence of pancreatic fistula after

gastric resection is particularly associated with the excision of an ulcer which has invaded the head of the pancreas Although the common duct is rarely injured the duct of Santorini opens 3 to 4 centimeters above the orifice of the ampulla of Vater Unless the surgeon constantly keeps both pancreatic ducts in mind, it is quite easy to sever the lesser one and cause leakage of pancreatic juice with peritonitis, and, or fistula formation

#### PREVENTION OF SKIN EROSION

Digestion of the skin in pancreatic fistula is dependent on trypsin which is secreted in the inactive form of trypsinogen Agents capable of activating trypsinogen include bacteria and their filtrates as well as exposure to air In a case with an infected cystic cavity, marked digestive properties will be evidenced as soon as the juice is secreted When no infection is present, however, digestion will appear only if the juice is kept in contact with the skin long enough to become activated The former case is more difficult to handle, but the problems are essentially the same in either event

Once a definite fistula with a small cutaneous orifice is established a catheter can readily be inserted and the secretion allowed to run into a bottle (Fig 3) Because of the fact that the fistulous tract was gradually dilated by the indwelling catheter, thus resulting in leakage and skin damage, it was found necessary to insert a slightly larger catheter every 2 weeks

The real problem with these fistulas, however, is in the early days when the entire wound is open, when wound digestion is taking place and before a catheter can be used Potter has recommended the use of beef juice extract and one tenth normal hydrochloric acid in the form of local application for the treatment of intestinal fistulas Since pancreatic juice is the offending agent here this method should prove very effective in preventing tissue digestion in pancreatic fistulas Local applications of protective agents, such as bronze powder, kaolin, tannic acid, and zinc oxide paste have also been used, but Potter's procedure has the particular merit of precluding digestion by acidifying and thus lessening the hydrogen ion concentration to the point where pancreatic trypsin is ineffective In addition beef extract supplies a substance for digestion in case any tryptic effect is not abolished and thus spares the body tissues

#### SUMMARY AND CONCLUSIONS

Soda in large amounts quite appreciably lessens pancreatic secretion Of various diets used a high fat, low carbohydrate regimen resulted in the least

secretion Atropine and feeding of pancreatic juice were of no value in diminishing the flow of pancreatic juice

Preventive measures which can be used to preclude the formation of pancreatic fistulas are (1) primary anastomosis of cysts to the gastrointestinal tract and (2) precautions not to injure the duct of Santorini while mobilizing the duodenum for gastric resection

Once a fistula is established the treatment will vary depending upon the amount of pancreatic secretion which is draining externally. Conservative measures should always be tried first to effect possible closure. In determining whether or not surgery is indicated, the following criteria should be employed (1) failure of conservative therapy, (2) history of closure followed by pain, vomiting, and epigastric tumor or cyst formation

The transplantation of pancreatic fistulas is a relatively safe and very successful surgical procedure with a mortality of 3.8 per cent in 26 collected cases

We have reported a successful case of pancreatojejunostomy. Other similar cases in the literature are reviewed. An attempt has been made to review and evaluate conservative methods of treating this condition as well as the preventive surgical measures which can be used to preclude the formation of pancreatic fistulas

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# EVIPAL ANESTHESIA AND THE COMBINATION OF INTRAVENOUS WITH GENERAL AND LOCAL ANESTHESIA<sup>1</sup>

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THE value of intravenous evipal anesthesia has been established definitely within the last 2 years. Its technique, dosage, advantages, and disadvantages therefore need but brief consideration. However, it seems justifiable to discuss more extensively its field of indications and the possibilities of its combination with other methods of general and local anesthesia. We shall consider the following points:

1 Evipal for short, independent anesthesia of brief duration for minor surgery

2 Evipal to induce anesthesia, and combined and prolonged by means of ether, nitrous oxide or ethylene for prolonged deep anesthesia for major surgery

3 Evipal combined with local infiltration especially in fracture surgery

4 Evipal combined with regional anesthesia (spinal, paravertebral, sacral, and splanchnic anesthesia)

## TECHNIQUE AND DOSAGE

Since the technique of evipal anesthesia has been described recently in more or less elaborate publications, it suffices to say that as a rule from 8 to 10 cubic centimeters of the 10 per cent solution of evipal soluble should be administered intravenously in adults immediately before the operation. During the injection, within the first 3 minutes, complete relaxation occurs, primarily with a relaxation of the lower jaw. The support of the mandible by an assistant or nurse is imperative. The duration of the injection should not be less than 3 and not longer than 5 minutes. In order to obtain prolonged and sufficiently deep relaxation, it is advisable to inject the first half of the required dosage more slowly. This particularly will enable the anesthetist to observe better the onset of the narcosis which sometimes appears in from 30 to 50 seconds. Evipal should be given on the operating table with the surgeon prepared to begin his procedure. This holds true for those cases in which evipal is used alone. If it is used as an induction anesthetic together with ether or gas, then the intravenous injection should be

administered in a preparation room adjacent to the operating room to avoid psychic trauma and excitation.

The amount administered in the average adult case varies from 8 to 10 cubic centimeters. However, it is difficult to outline a standard dosage table. In a former paper we published a table which may be used as a guide. At that time we discussed the results obtained in 600 cases in which intravenous evipal anesthesia had been used. In cases of anemia, cachexia or gravely ill patients, one should subtract some 20 to 30 per cent from the usual amount injected, strong or very resistant patients, especially in the age group from 15 to 40 years, one should add from 10 to 20 per cent of the amount calculated from the table mentioned. The anesthetist should not follow any strict rule but must be guided in the individual case by the reaction during the induction and by his own judgment after personal experience with this type of intravenous anesthesia. This is just as true for intravenous anesthesia as it was in the case of rectal avertin anesthesia, because both methods have the one common disadvantage: they are not easily controllable. This drawback, however, is not as great in the case of evipal as it is not only very quick in action but also of short duration. Evipal is rapidly detoxified by the body and eliminated during the actual time of anesthesia. The liver plays an important part in this process of detoxication. The heart is not affected nor are the kidneys. The blood pressure falls only from about 15 to 20 millimeters. The pulse as a rule shows no change. The respiration during anesthesia is deep and regular. No deleterious effects could be observed in the body metabolism or in its alkali reserve. There is no stage of excitation. In some cases we could observe a slight tremor of the extremities which disappeared, however, when the anesthesia became deep enough.

## DURATION OF EVIPAL ANESTHESIA

The average evipal anesthesia lasts for 15 to 20 minutes, sometimes 25 minutes. It is difficult, however, to make a definite statement as to the actual length of anesthesia. There is no accurate correlation between dosage, duration, depth of

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sleep, weight or age. These are only relative factors and the anesthetist must exercise his own judgment in considering them for the actual procedure. For this reason we want to stress again the point that full reliance should not be placed upon the tables or formulas which have been published by Anschuetz, Specht, Klages, and ourselves. No nurse should ever be allowed to administer intravenous anesthesia. This again shows that there is need for a doctor anesthetist who knows the physiology, pharmacology, and pathology of the human body. This knowledge will enable him to give individual anesthesia for an individual case. As an example of the difficulties encountered in judging the exact dosage and duration Beck reports that a strong man of 36 years slept for 10 minutes after the injection of only 2 cubic centimeters of evipal while another man of the same age and weight slept for only 6 minutes after 5 cubic centimeters.

There are no deleterious after-effects; no vomiting; very rarely there is slight postanesthetic excitement with tremors of short duration. In most of the cases the patient will awaken 20 to 30 minutes after the injection and is able to get up from the table and walk home. Depending on the operation, dosage and the depth of sleep, the patient should be cautioned to wait from 15 to 30 minutes before getting up. There is no contra-indication whatsoever to using evipal anesthesia in out patient departments if the drug is administered by a competent anesthetist. It can be given to children and aged patients with equally good results.

There have been reports in the literature on the possibility of performing major operations (stomach resection, abdominal and rectal surgery) by giving evipal repeatedly during the operation. This was done by Buerkle de la Camp, Reschke, and others, by leaving the needle in the vein or using a two way syringe preventing the clogging of the vein by the infusion of salt solution. In spite of the fact that such a fractional method of instillation can be employed, we do not advise this procedure. We do not as yet know the exact dosage of evipal indicated and as the uncontrollability of an intravenously administered anesthetic must be considered we believe it wise to apply the drug within the range of its applicability. We have also used it during preliminary investigations in some prolonged operations. In one case of removal of a foreign body (shotgun bullet) from the cervical spine 23 cubic centimeters of evipal was administered in repeated instillations during a period of approximately 1 hour and 20 minutes. The relaxation was not adequate

nor was the condition of the patient. However, there are much better ways for prolonging and combining evipal anesthesia which are discussed later on in this paper.

#### CONTRA INDICATIONS

We believe evipal to be contra indicated in the following:

- 1 Patients with liver damage (acute yellow atrophy, ascending cholangitis, severe hepatitis) should not be given evipal since the liver is the main organ in which the drug is detoxified.

- 2 Severe septic patients and those with general blood stream infections should be eliminated or at least given only very small doses.

- 3 Patients with mechanical interference with the air passages (septic angina, Ludwig's angina, the presence of a foreign body in the upper respiratory tract) are not suitable subjects for this type of anesthesia.

When an overdosage of evipal is given, respiratory irregularity or even cessation of respiration may occur. In these cases we have a most valuable efficient aid in coramine. We have administered in some patients to whom too high a dosage had been given, 5 cubic centimeters of coramine intravenously and another 5 cubic centimeters intramuscularly, the latter in order to obtain a protractive effect. Respiration returns during or immediately after the injection. If one supports the measure with artificial respiration together with inhalation of carbon dioxide or oxygen, the danger of overdosage can easily be overcome. *These two factors—first the uncontrollability of every intravenous anesthesia and second the relatively uncertain dosage—are the only disadvantages of this otherwise ideal anesthetic.* Its advantages are obvious and the anesthetist who combines experience with modern viewpoints regarding the individual indication for anesthesia should not fail to use it. The question to answer is, how to place this efficient anesthetic in its proper field.

#### INDICATIONS

The indications for the application of intravenous evipal anesthesia are four, as follows:

- 1 *Evipal as an independent anesthetic used alone for a short anesthesia for minor surgery.* Here is a field for its use in out patient departments and in a well equipped doctor's office if adequate help is available. The indications are incision of abscesses, carbuncles, felon, phlegmons, sebaceous cysts, ingrown nails, hand infections, finger amputations, finger fractures, Colles fractures, reduction of dislocations, small biopsies,

excisions, lacerations, thoracocenteses, anal fissures, hemorrhoids, dilatation and curettage, excision of Bartholin's glands, during third stage of labor, for episiotomy and repair of pelvic floor and also for painful dressings

We have used it in many cases of this kind with very satisfactory results. It is of particular value in large out patient departments when a great number of accidents, abscesses, etc., have to be treated in a short time. This procedure can easily be performed within 10 to 15 minutes and the patient can leave immediately after awakening or at least within the next 15 to 30 minutes without any after-effects. It is particularly adapted to the reduction of Colles' fractures. In several cases the radius fracture was reduced and the plaster applied, the patient awakening only after the whole procedure had been performed.

2 *Evipal combined with inhalation anesthesia*  
Evipal has proved to be of particular value when used as induction anesthesia, combined and prolonged with ether, nitrous oxide or ethylene. The amount of ether and the concentration of the gas could be limited and decreased by this combination. By giving evipal first, there is no excitation stage. Many patients are afraid of ether or gas and the psychic shock is largely avoided or does not occur at all when evipal is administered intravenously in a room adjacent to the operating room just previous to the inhalation anesthesia. Psychically labile patients render an ideal field for this indication. We have used it in many such cases with routinely good results. It can readily be given to patients in surgical shock, thus saving considerable time and loss of blood as well as reducing the amount of general anesthesia. When nitrous oxide is used and relaxation is unsatisfactory, anesthesia can be deepened for 15 minutes by injecting evipal. This enables the surgeon to start abdominal operations with gas and to give evipal only for the time when better relaxation is necessary (gastro enterostomy, gastrotomy, appendectomy). This procedure seems to be much more satisfactory than forcing large doses of evipal alone or giving it repeatedly for too long a period of time in those major surgical cases in which an anesthetic of deeper and wider range is indicated.

3 *Evipal combined with local infiltration anesthesia*  
The combination of intravenous anesthesia and local infiltration has its field of indication which has been too infrequently utilized. Since the use of local infiltration anesthesia is in some instances limited, evipal affords an ideal means of overcoming some of these difficulties and greatly widens the field of possibilities for local

anesthesia. A few examples may be cited. In cases in which the operation extends beyond the infiltrated area (prolongation of incisions) or whenever the local infiltration is not sufficient for the particular type of operation, the intravenous evipal anesthesia will help overcome pain and distress. When local anesthesia is employed in abdominal or inguinal hernia restlessness or pain from pulling on the cord may be distressing. A few cubic centimeters of evipal will enable the surgeon to work undisturbed. In thyroidectomy when dissecting the upper pole under local anesthesia, pain may be caused. Here a short intravenous anesthesia is of inestimable value in nervous patients. Within a few minutes the patient is again able to respond to the questions of the surgeon, which is essential to avoid injury of the recurrent laryngeal nerve.

We particularly want to mention combined intravenous and local anesthesia in fracture surgery. In a former paper the author discussed the indications for operative procedures in fractures of the long bones. Here we will outline some of the indications for combined local and intravenous anesthesia.

A. In some fractures of the finger, wrist, radius or ulna *Boehler's technique* may be used by injecting novocain at the site of the fracture. If sufficient relaxation of the spastic muscles is not obtained it can be easily secured by injecting from 5 to 10 cubic centimeters of evipal intravenously, which yields sufficient anesthesia to effect reduction and application of splint, plaster, etc. Also in tibial fractures in which the local injection of novocain may prove to be insufficient, muscular relaxation can be obtained by evipal. In compound tibial fractures in which operation under local novocain infiltration is feasible, it is often advisable to give a short intravenous evipal anesthesia for debridement, reduction, and fixation in order to have perfect relaxation. This procedure has been utilized successfully in several cases. As a matter of fact we have used it in preference to other types of anesthesia.

B. *Koenig's method of local anesthesia* consists of a circumferential infiltration of the extremity combined with several radial injections of novocain from skin to bone, including the periosteum. It may be successfully employed in fractures of both the lower and upper extremities. Occasionally sufficient relaxation is not obtained due to pain and muscle spasm proximal to the point of infiltration. These muscle spasms can readily be overcome by administering evipal. In using one of these local anesthesia methods together with evipal, one opens wide the field of fracture surgery.

to the application of the least detrimental anesthesia. We thus combine the much desired benefits of local anesthesia with complete muscular relaxation by a short non dangerous anesthesia. In our experience satisfactory results were obtained in all cases.

*C. II* *hen Kuhlenskampff's brachial plexus anesthesia* is used for operations on the upper extremity (humerus, elbow, supracondylar, olecranon, forearm fractures, etc.), sometimes the nerve block alone may not render sufficient relaxation. This does not reflect upon the value of this anesthesia but may be due to incomplete flooding of the brachial plexus with novocain. In these instances evipal anesthesia will prove of definite value. Brachial plexus anesthesia naturally should be classified under the methods of regional or block anesthesia. It is mentioned here, however, for the reason that the various anesthesia procedures for fracture surgery are discussed at this time.

*4. Intravenous anesthesia combined with regional anesthesia*

*A. Spinal anesthesia* has a well established field of indication. We have stated previously that evipal anesthesia does not have any marked effect on the blood pressure. For this reason there is no objection to combining it with spinal anesthesia. There are several indications. Excited or psychically labile patients can be more easily handled when evipal is given first in order to quiet the patient. Only a few cubic centimeters are necessary (3 to 6) in order to insert the spinal needle in the subarachnoid space without pain, the breaking of the needle by an agitated patient is thus avoided. When the operation under spinal anesthesia takes a longer time than planned, anesthesia can be prolonged with evipal. If relaxation is not deep enough due to the fact that too small a dose had been given intradurally or that there is insufficient anesthesia higher than the intradural block, it can be augmented by intravenous anesthesia.

*B. The value of paravertebral anesthesia* in renal surgery has been previously discussed by the author. In the years 1927 to 1929 we published reports of 425 paravertebral anesthetics in urologic surgery with good results. At that time, we stressed the point that in spite of a technically perfect paravertebral block there may be pain from pulling on the kidney pedicle due to the sympathetic fibers which accompany the vessels. We had to overcome this annoyance in some cases with ether or gas, since a good intravenous anesthetic of brief duration was not available. We would like to recommend the combination of para-

vertebral anesthesia with evipal for urologic surgery. For nephrectomy and pyelotomy the injection of the twelfth dorsal and the first lumbar segment is sufficient, for ureter operations the lower segments (two to four) have to be added. The operation is started under the paravertebral block and then evipal is administered only during the short time of unavoidable traction on the pedicle, vessels, and ureter. It may be that this combination will persuade some anesthetists to avail themselves of the definite advantages of the paravertebral block in a greater range of conditions when supplemented by the effect of a short intravenous anesthesia.

*C. Sacral or caudal anesthesia* or epidural anesthesia, as it is also known, renders a field wherein intravenous anesthesia is of value. All users of sacral anesthesia have occasionally encountered difficulties. In 1929 we published reports of 370 cases operated on under sacral anesthesia. Fifteen patients required additional anesthesia for which ether was employed. It is not very advisable, however, to use ether because of the marked excitation stage. Evipal is a much better agent for overcoming the painful moments of the sacral block. It is particularly helpful in the performance of a prostatectomy when the pulling on the capsule or on the neck of the bladder may cause pain.

*D. As to splanchnic anesthesia* the same indication holds true. Whether one uses the anterior method (Braun) or the posterior splanchnic block (Kappis), we as well as others have occasionally observed that relaxation was not complete. Traction on the stomach or mesentery may cause pain for instance in gastric resection, gall bladder, and duodenal surgery. When traction in the splanchnic region is unavoidable, it seems advisable to make use of the benefits of a short intravenous evipal anesthesia. Since there is no excitation stage, the surgeon is not disturbed as is the case when splanchnic anesthesia has to be supplemented by ether with the consequent pre-anesthetic and postanesthetic nausea, vomiting, and excitation.

#### SUMMARY

The technique, dosage, and advantages of intravenous evipal anesthesia are briefly discussed. An effort has been made to stress particularly the wide field of indications, especially its value in fracture surgery and in combination with local and regional anesthesia. Among these are discussed the combination with Boehler's anesthesia, Kuhlenskampff's plexus anesthesia, Koenig's method and spinal, paravertebral, sacral, and

splanchnic anesthesia. The results justify the use of this intravenous method. It is a reliable aid to the surgeon and anesthetist when properly used in each individual case.

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The technique, dosage, and advantages of intravenous evipal anesthesia are briefly discussed. An effort has been made to stress particularly the wide field of indications, especially its value in fracture surgery and in combination with local and regional anesthesia. Among these are discussed the combination with Boehler's anesthesia, Kuhlenskampff's plexus anesthesia, Koenig's method and spinal, paravertebral, sacral, and

splanchnic anesthesia The results justify the use of this intravenous method It is a reliable aid to the surgeon and anesthetist when properly used in each individual case

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# COMPLETE DISLOCATIONS OF THE KNEE JOINT

## A Report of 7 Cases with End-Results<sup>1</sup>

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JUDGING from personal experience and a review of the literature, complete dislocations of the knee are still rare, despite the ever increasing hazards of modern transportation and industry. The average hospital has admitted not more than 2 or 3 patients with such injuries and many, none at all. These dislocations if present on admittance to the hospital are frequently reduced immediately by the resident staff, and for this reason escape the attending surgeon's observation until a later date.

The literature on this subject, therefore is woefully lacking in information and is full of conflicting opinions as to the proper treatment. Since the condition is so rare most of the articles written are based upon the observation of a single case.

It is our purpose at this time to present 7 cases of complete dislocation of the knee joint, to describe the treatment used, and to report the late results. In 1 case 14 years has elapsed since the injury. All patients were treated in the Employees' Hospital by the orthopedic service.

The treatment of dislocation of the knee joint after reduction has been accomplished resolves itself fundamentally into the treatment of the injured ligaments which support the knee. It is necessary, therefore, to review briefly the anatomy and function of these important structures. Because of the large surface area of the articular surfaces of the knee joint any complete dislocation necessarily causes a rupture and tearing of the ligaments about the knee.

The knee joint is supported and stabilized directly by many important ligaments and indirectly by the muscles and tendons which reinforce the ligaments. The crucial ligaments are located in the interior of the joint and serve chiefly to stabilize the knee in the anteroposterior plane. They also contribute to a lesser degree to

stabilization in the lateral plane. The anterior crucial aids in preventing the tibia from being dislocated anteriorly and is the first of the crucials to be ruptured in anterior dislocations of the knee. The posterior crucial likewise prevents posterior dislocation of the tibia on the femur and is the first of the two to rupture in posterior dislocations of the knee.

However, as Philip Wilson (15) correctly points out, "the lateral ligaments constitute the outer defenses of the crucials and injury to the latter scarcely ever occurs without accompanying damage to the former." The internal and external lateral ligaments are the strongest ligaments of the knee joint. They serve chiefly to stabilize the knee in the lateral plane. It is highly probable that the importance of these has been underestimated while that of the crucials has been overestimated.

The small and less important internal and external lateral patella ligaments are located anterior to the lateral ligaments. The quadriceps muscle and tendon and the patella tendon support the knee joint anteriorly. The strong, oblique popliteal and arcuate popliteal ligaments support the joint posteriorly. Besides the ligaments of the knee, all the muscles of the thigh having attachments below the knee aid in supporting this joint. The two heads of the gastrocnemius also add strong support (Fig 1, A).

Complete dislocations of the knee joint are classified according to the relation of the upper end of the tibia to the lower end of the femur. The tibia may be dislocated in one of five positions on the femur and they are named in the order of frequency: (1) anterior, (2) posterior, (3) lateral, (4) medial and (5) rotary (Fig 1, B).

Complete dislocations of the knee joint are caused by severe direct or indirect violence. The type of dislocation received is dependent upon the direction and location of the violence. When a direct blow is received upon the external side of the knee above the joint, the femur is driven inward resulting in a lateral dislocation. If the blow strikes below the knee, the tibia would be driven medially producing a medial dislocation.

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Likewise, direct blows received on the front or back of the leg may cause anterior or posterior dislocations, according to whether the blow lands above or below the knee. Anterior dislocations usually occur when the knee is extended and posterior dislocations when it is flexed. Rotary dislocations are usually caused by getting the foot caught in a rotating wheel.

Dislocations may also result from indirect violence as occurs when one is standing in a fallen elevator or when one steps into a hole while running. All cases are not dislocated in one plane only. Some cases may be complete dislocations in one plane and partial in the other. Case 1 reported here will illustrate this as it was a complete posterior dislocation and a partial medial. The ligaments may be so badly disrupted that the position of the dislocation will be difficult to classify.

Injuries to structures other than the joint and ligaments sometimes occur and may cause serious complications. Serious fractures in complete dislocations are rare. Chip fractures of the condyles of the femur or tuberosities of the tibia, however, occur occasionally and are more common in dislocations in the lateral plane than in the antero-posterior plane. Fractures of the tibial spine are common. The semilunar cartilages may be fractured or dislocated, causing difficulty in reduction. The capsule of the knee joint is usually extensively lacerated, but a narrow tear may result in irreducibility, which will necessitate open reduction. A dislocation may be compounded and is a serious complication. Injuries to the blood vessels in the popliteal space rarely occur. Rupture of the popliteal artery may result in gangrene. Anterior dislocations are accompanied by this complication more than any other type. This is because of the anatomical fixation of the popliteal artery (10). It is possible, however, for only the intima of the artery to be injured and cause a delayed gangrene. Aneurysms sometimes develop but are rare. Nerve injuries, especially injury to the common peroneal, are not infrequent but are seldom permanent. There may, however, be complete severance of the nerve resulting in permanent injury, if proper treatment is not carried out.

The diagnosis is not difficult. The history of a severe injury and the gross deformity are self-evident. Pain and preternatural mobility are usually present on attempts at movement of the extremity. Roentgen examination should be made if possible, as this will reveal any associated fractures and the exact type of dislocation. Complications should always be looked for.

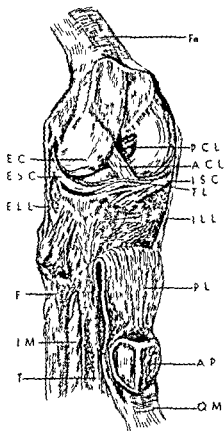


Fig 1, A. The important ligaments of the knee joint. E C, External condyle, E S C, external semilunar cartilage, E I L, external lateral ligament, F, fibula, I M, interosseous membrane, T, tibia, Fe, femur, P C L, posterior cruciate ligament, A C L, anterior cruciate ligament, I S C, internal semilunar cartilage, T L, transverse ligament of semilunar cartilages, I L L, internal lateral ligament, P L, patellar ligament, A P, articular surface of patella, Q M, tendon of quadriceps muscle. (Sketched from Toldt's *Atlas of Human Anatomy*.)

Any complete dislocation of the knee joint should be properly splinted and sent to a hospital where proper treatment can be instituted. It is only by the institution of early proper treatment that instability of the knee may be prevented.

Closed reduction at the earliest possible moment is imperative. General anesthesia is indicated in most cases because a relaxation of the muscles is necessary. Such procedure prevents further stretching and possible tearing of the already overstretched muscles, tendons, nerves, and vessels. Reduction is usually accomplished without difficulty and should be performed by traction on the leg and pressure and counter pressure on the dislocated lower end of the femur and upper end of the tibia. Hyperextension of the leg or increasing the deformity is not only unnecessary but dangerous in that it may cause a rupture of a vessel or tearing of a nerve. If closed reduction is impossible, a dislocated semilunar cartilage or a narrow tear in the joint

In order to clarify the study, the cases have been divided into three groups, as follows

Group 1 consists of 22 cases which were bacteriologically proved and which were not complicated by bone infection. This group constitutes the main series upon which this study is based.

Group 2 consists of 4 cases similar in every way to the above except that they were not bacteriologically proved.

Group 3 consists of 10 cases, all proved bacteriologically but which were complicated by osteomyelitis at the joint.

#### Group 1

Twenty-two cases, bacteriologically proved, uncomplicated

*Incidence* There were 5 females and 17 males, a ratio of 1 to 3.4. Age at operation ranged from 6 months to 14 years (except for one male of 32).

The hip was affected in 10 cases, or 45.5 per cent, the knee in 6, or 27 per cent. There were 3 elbows, 2 ankles, and 1 shoulder.

*Etiology* With one exception (Case 11 Table I), all the infections in this group were of metastatic, hematogenous origin. The etiology of such infections can rarely be definitely established. A history of definite trauma was obtained from 5 patients, and in 15, or 68 per cent of the group, there was evidence of foci of infection which might have had a causal relationship. Only two patients had neither foci of infection nor trauma.

The foci of infection encountered, in the order of their frequency, were infected tonsils, chronic osteomyelitis in a distant bone (i.e., a bone not entering into the formation of the affected joint), otitis media, pyelitis, septicæmia, purulent cervical adenitis, pneumonia.

*Symptoms and physical signs* did not differ, in this series, from the usual textbook descriptions of the most constant symptoms were pain and inability to use the affected joint, with swelling in all cases except some of those in which the hip was affected. Varying degrees of general reaction were present, from high fever and prostration to moderate pyrexia and malaise. The duration of symptoms averaging 9 days. Often the patient had been treated at home, during these important days, without a correct diagnosis.

The temperature per rectum ranged from 99.4 to 103 degrees F., the mean temperature on admission being 102 degrees F. The white blood cell count was listed as low as 6,800 and as high as 52,800, with a mean of 16,800. The mean per-

centage of polymorphonuclear leucocytes was 72 per cent

*Röntgenograms* strongly suggested pyarthrosis in 9 cases, in 7 cases the evidence from this source was less helpful, while 6 patients had no pre-operative roentgenogram.

*Diagnosis* This is more difficult than one is led to believe. Especially is there difficulty in the differential diagnosis between this condition and (a) joint tuberculosis, (b) acute rheumatic fever, (c) sympathetic sterile effusion into a joint near infected area, as osteomyelitis or cellulitis.

(d) acute non suppurative infectious synovitis. There is no single test for joint supuration. The history, physical examination, clinical laboratory reports, and roentgenograms must all be carefully studied, and observation in the hospital for a day or two may be necessary to arrive at a diagnosis. It is probably less serious to open a sterile joint than to fail to open a purulent one, although in the presence of surrounding inflammation the most acute surgical judgment is needed to make such a decision.

*Aspiration* of the exudate for the purpose of diagnosis is invaluable. This should be performed in every case in which there is any doubt about the diagnosis, smears and cultures being made immediately, even if both of these are negative, however, roentgenology should be performed if the clinical and roentgenographic signs are sufficiently suggestive of sup-puration.

The positive diagnosis of pyarthrosis cannot be made in the early stages from the roentgenogram alone, but when an effusion, the density of which is consistent with pus, is seen in a joint having the necessary history and physical signs, that diagnosis is strongly suggested.

*Operation* In 20 patients of Group 1 the purulent joint was treated by wide arthrotomy, and a drain was placed in the joint cavity in each case, to ensure continued evacuation of the pus. The material used for these intracapsular drains was soft rubber dam or soft gutta tubing, heavy walled rubber tubes were placed down to capsule when necessary to preserve a drainage tract through thick muscle layers, as at the hip. All drains were usually sutured in place. At the knee, the rubber dam was often placed completely through the joint, traversing the suprapatellar pouch.

Infections were placed in dependent situations when the anatomy of the joint made this feasible, as, posteriorly at the hip (except in 2 cases, and shoulder, posterolaterally at the elbow, at the knee, two longitudinal incisions were made, one on each side of the patella.

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In the 2 remaining joints of Group 1, arthrotomy was not performed for the reason that the diagnostic aspiration of pus was followed by rapid, unexpected, and complete resolution of the infection. They were undoubtedly infections with attenuated organisms one an elbow from which *Staphylococcus aureus* was cultured, the other a pneumococcal infection of the knee (Cases 19 and 22). The diagnostic paracentesis had no such effect in the remaining cases.

**Pathology** Every joint in this series was a definitely purulent one when opened. In all cases pus was encountered varying in consistency from thin gray seropurulent exudate to thick, yellow, creamy pus. The synovial membrane<sup>1</sup> was usually severely injected and hypertrophied, with more or less necrosis, the capsule and periarticular structures were usually described as oedematous. Granulation tissue in many instances encroached upon the articular cartilage, but in every case in this group in which the operative note described it, the cartilage itself was said to be intact.

In no case in Group 1 was there any destruction of bone, either before the arthrotomy or subsequent to it. Nor was there any case of phlegmon extending from the joint through the fascial planes of the extremity.

**Microscopic sections** were made in only 6 cases. It has been the feeling in this hospital that the arthrotomy in a purulent joint should be done as quickly as possible with no unnecessary opening up of new tissue spaces to the infection. Hence the paucity of material for microscopic study.

<sup>1</sup>The sections which were made confirm the already well known pathological picture: a synovial membrane thickened by oedema, hypertrophy and hyperplasia; these processes extending also into the subsynovial areolar tissues to varying extents; synovial membrane and underlying tissue densely infiltrated with polymorphonuclear leucocytes, and more or less extensive necrosis of the superficial layers of synovial membrane.

**Bacteriology** Positive cultures were obtained from all the joints in Group 1. The organisms encountered in the order of their frequency, were

	Cases	Per cent
<i>Staphylococcus aureus</i>	7	32
Hæmolytic streptococcus	4	18
Non hæmolytic streptococcus	3	14
<i>Staphylococcus plus streptococcus</i>	3	14
<i>Pneumococcus</i>	3	14
<i>Staphylococcus</i> (variety not stated)	1	4.5
<i>Bacillus pyocyaneus</i>	1	4.5

The *Bacillus pyocyaneus* is not common in this disease, in this case an operation on the prepa-

tellar region, performed at another hospital, resulted in a *Bacillus pyocyaneus* infection, and the patient was brought to us after the knee became involved (Case 11).

The virulence of these organisms and the results obtained in joints infected with each, will be discussed presently.

**Complications** The complications usually spoken of in treatises on acute suppurative arthritis are septicæmia, osteomyelitis, phlegmon, ankylosis, amputation, death. None of these untoward events occurred in any case in Groups 1 and 2 of this series. One patient (Case 21), with a purulent shoulder, had several recurrences requiring arthrotomy, another had a pathological dislocation of the hip. There were no other serious complications.

**Postoperative treatment** *Motion* Gentle passive motion was instituted immediately after the operation, and this was replaced by active motion as quickly as the patient was able to bear it. The average time at which active motion was begun was 2.5 days after operation, although records of this were not kept on all of the charts. In 2 cases (12 and 14) the arthrotomized knee had to be moved under anaesthesia at 6 weeks and 12 days, respectively, because of stiffness. Both of these patients obtained good, but not excellent, results.

**Removal of drains** depended upon the decrease in drainage and the patient's temperature. The rule was gradually to withdraw the drain as fast as the subsidence of the infection would allow. Complete removal usually occurred between the seventh and twenty first days, though it varied between the first and the fortieth days after operation. Dakin irrigations were used in 1 case.

**Traction** was used in 10 of the 18 cases of lower extremity involvement: 8 hips and 2 knees were thus treated. No figures were available as to how long the traction was maintained.

**Weight bearing** was not forced. The earliest day on which walking was begun in a lower extremity case was the twenty eighth day after operation, and the average was 45 days. The date was determined by the general condition of the patient and the appearance of the joint.

**Results of the operations** All but 9 of the patients were seen and examined by the authors in the follow up clinic, and their condition at the time determined as accurately as possible. When it was impossible to get a patient in for examination, his condition was estimated from the most recent notes on his history.

The length of time elapsed between operation and final follow up examination for this group averaged 4.3 years, there being only 1 case with a

follow-up of less than 1 year, and the longest period being 14 years

The result of the treatment in each case was evaluated according to the anatomical, symptomatic, and functional condition of the joint at the time of last examination, the degree of success obtained by the operation was indicated numerically from 0 to 4 in each of the named categories of anatomy, symptoms, and function, representing a failure, 1, a poor result, 2, fair, 3, good, and 4, an excellent result. This system of follow-up evaluation was originated at the Presbyterian Hospital in New York City in 1914, and was described in *The Medical and Surgical Reports* of that institution in 1918, by Dr James A. Corner. According to this system an excellent result is designated an anatomical 4, symptomatic 4, functional 4, or more simply as 4-4-4, a complete failure would be 0-0-0. A patient who had a good anatomical, excellent symptomatic, but poor functional result would be classed 3-4-1.

In estimating the anatomical result of the operations, account was taken of such variations from the normal as shortening, atrophy, bone destruction, relaxation, subluxation, dislocation, deviation, deformity, ankylosis. For the symptomatic result, the patient's complaints of pain, stiffness, limp, and pain were weighed. To determine the functional or economic result, a careful study was made of the exact range of motion at the joint, these measurements being made personally by the authors in most of the cases, also the gait, the handicap in work or athletics, the ability to execute skilled movements were studied.

The personal judgment of the authors was necessarily called into play in arriving at the numerical classification of these cases, particularly of those not examined personally in the follow-up clinic. If there was any difficulty in estimating any phase of a result, the classification was purposely made to err toward the lower rating. If ankylosis occurred in any joint, it was considered an anatomical as well as a functional failure. Table I gives a short resume of every case in the series, with its anatomical, symptomatic, and functional result and the numerical classification.

Of the 22 patients in Group 1, there were 12, or 54 per cent, in whom the anatomical, symptomatic, and functional results were all excellent, i. e., 4-4-4 results, or joints restored practically to normal. These patients have little if any residual of the disease apparent in the roentgenogram, no pain, stiffness, or limp, and no limitation of motion or activity.

Ten cases, bacteriologically proved, with bone involvement

TABLE II—END-RESULTS ACCORDING TO GROUPS

End Result	Group 1	Group 2	Group 3
4-4-4	12	2	
3-4-4	1		
3-4-3	2		2
3-4-2	1		1
3-3-3	1		
2-4-4	1		
2-4-3			1
2-3-2			1
1-2-0			1
0-4-0		1	2
0-3-0			1
3-0-0	1		
0-2-0	1		1
Unclassifiable	2	1	
Total No. of Cases	22	4	10

The average age of this group was 57 years, and the average duration of symptoms before operation was 49 days (in Group 1 it was 9 days) exclusive of one patient who had been treated in another hospital in a spica, without operation, for 200 days.

Symptoms, physical signs, temperature, and blood counts did not differ materially from the cases in Group 1.

The causative organisms were staphylococcus in 4 cases, streptococcus in 4, mixed staphylococcus and streptococcus in 1, and mixed streptococcus and *Bacillus coli* in 1.

The arthrotomy and insertion of drain in this group had to be followed in all but 2 cases by subsequent operations for the removal of sequestra, partial osteotomy, or to widen the drainage tract. Hence the pathology and the postoperative course were somewhat different from the cases in Group 1. It was impossible to say whether the osteomyelitis or the arthritis was the original lesion in these cases, there is little doubt however, that an undiagnosed, untreated pyarthrosis at the hip could be expected to cause bone infection sooner or later.

Traction was used in 6 of these cases, and a plaster spica in 1. Attempts to establish motion met with much less success than in the uncomplicated cases. The removal of drains, healing of sinuses, and length of stay in bed were determined by the progress of the osteomyelitis rather than by the joint infection.

The follow up period for this group averaged 7 years. Among the 10 cases there were no excellent results, although 6 patients were completely relieved of symptoms, 4 results may be called good (Cases 30, 31, 32, 34), 1 poor (Case 28), while 5 were failures. Four of the failures were due to ankylosis, 1 to an irreducible dislocation which was present on admission. There were no deaths,

amputations, or cases of septicemia, the one phlegmonous abscess was present on admission in the patient (Case 33) who had lain 200 days in a spica in another hospital, and was undoubtedly due to the long delayed operation.

Thus 50 per cent of the cases in this group resulted in failures with no excellent results. When the outcome of these cases is compared with that of the cases in Group 1, it is seen that the presence of bone infection as a complication of purulent arthritis greatly increases the seriousness of the disease, and renders the prognosis for function much less sanguine. Table II shows graphically the results in each group.

#### FACTORS INFLUENCING FINAL RESULTS

The results of the treatment in this series of cases are surprisingly good when compared with the case reports in the literature. The factors which may have some bearing on this difference will be discussed under the following headings.

1 *Virulence of the infection* There were, of course wide variations in the virulence of the infecting bacteria as is shown by the fact that one patient with a *Staphylococcus aureus* infection of the knee recovered after simple aspiration, whereas others with the same organism were prostrated with a very severe infection and ended with poor joints in spite of early and efficient treatment. Low virulence of the bacteria may account for some of the excellent results obtained in this series, but that it cannot account for all of them will be evident to one who studies the figures for temperature and blood counts given in Table I. It may not be unusual to see a joint infected with the pneumococcus get well with aspiration, but this must certainly be an unusual event with the staphylococcus. The authors cannot speak with experience about the result of aspiration as the sole method of treating streptococcus pyarthroses. Table III shows the end results of the cases in Group 1 arranged according to the infecting organism.

2 *Early diagnosis and arthrotomy* There was little temporizing with purulent joints in this series. Arthrotomy was performed in each case as soon as was feasible after the diagnosis was made. The only delay was in the patient's getting to the hospital. The best results in general, were obtained in those joints which had early diagnosis and early arthrotomy.

3 *The use of drains* Far from constituting a misdeed, it is believed that the results in this series of cases will show that the use of soft rubber drains into the joint cavity is one of the most helpful adjuncts in the treatment of pyogenic joints.

TABLE III—END RESULTS IN GROUP I ACCORDING TO INITIATING ORGANISM

Result	4-4-4	3-4-4	3-4-3	3-4-2	3-5-3	2-4-4	3-0-0	0-2-0	Un- class- ified	Total No of cases
<i>Staphylococcus aureus</i>	4	1	1	2	1	1	1	1	2	8
<i>Hemolytic streptococcus</i>	4	1	1	2	1	1	1	1	2	4
<i>Non hemolytic streptococcus</i>	1	1	1	1	1	1	1	1	2	3
<i>Streptococcus and staphylococcus</i>	3	1	1	1	1	1	1	1	2	3
<i>Pneumococcus</i>	3	1	1	1	1	1	1	1	2	3
<i>Bacillus pyoverdans</i>	1	1	1	1	1	1	1	1	2	1

TABLE IV—END RESULTS IN GROUP I ACCORDING TO DURATION OF SYMPTOMS BEFORE OPERATION

Duration of symptoms in days	4-4-4	3-4-4	3-4-3	3-4-2	3-5-3	2-4-4	3-0-0	0-2-0	Un- class- ified	Total No of cases
1	1	1	1	1	1	1	1	1	2	8
2	1	1	1	1	1	1	1	1	2	4
3	1	1	1	1	1	1	1	1	2	3
4	1	1	1	1	1	1	1	1	2	3
5	1	1	1	1	1	1	1	1	2	3
6	1	1	1	1	1	1	1	1	2	3
7	1	1	1	1	1	1	1	1	2	3
8	1	1	1	1	1	1	1	1	2	3
9	1	1	1	1	1	1	1	1	2	3
10	1	1	1	1	1	1	1	1	2	3
11	1	1	1	1	1	1	1	1	2	3
12	1	1	1	1	1	1	1	1	2	3
13	1	1	1	1	1	1	1	1	2	3
14	1	1	1	1	1	1	1	1	2	3
15	1	1	1	1	1	1	1	1	2	3
16	1	1	1	1	1	1	1	1	2	3
17	1	1	1	1	1	1	1	1	2	3
18	1	1	1	1	1	1	1	1	2	3
19	1	1	1	1	1	1	1	1	2	3
20	1	1	1	1	1	1	1	1	2	3
21	1	1	1	1	1	1	1	1	2	3
22	1	1	1	1	1	1	1	1	2	3
23	1	1	1	1	1	1	1	1	2	3
24	1	1	1	1	1	1	1	1	2	3
25 plus	1	1	1	1	1	1	1	1	2	3

In one case the duration of symptoms was unknown

The drains must be soft, they must not be large enough to cause pressure necrosis, and they should be withdrawn as rapidly after operation as the subsiding of the infection will permit.

4 *Traction*. It is believed that the routine use of traction in these cases has exerted a favorable influence. Traction helps to relieve pain, to prevent or overcome flexion deformities, and possibly to protect the articular cartilages if, as Phemister claimed, necrosis of this tissue first occurs at points of pressure in a suppurated joint. The traction apparatus must be so applied that it will not interfere with free motion at the joint. The simplest method is by means of an ankle and a weight over a pulley at the end of the bed.

5 *Motion*. A great deal has been written in the literature about active versus passive motion, much to the discredit of the latter. It would be ideal treatment in pyogenic joints to start frequent, prolonged, and complete active motion immediately after operation, but such treatment can be attained only in rare instances. One needs only to see a single case to appreciate the suffering undergone by a patient with such a lesion, and when the average age of these patients is recalled, it becomes obvious that too much cannot be expected of active motion.

6 *The main purpose in the treatment of acute suppurative arthritis is, of course, the evacuation of the pus by the most efficient means possible. The use of drains and of early passive and active motion was invaluable in accomplishing this in the present series of cases, and the fact that these methods, when correctly used, are not destructive to infected joints is demonstrated by the end-results here reported.*

7 *An historical review of the treatment of acute suppurative arthritis is presented in Case reports of this disease are usually bad, literature, the results reported are usually bad,*

TABLE III—END RESULTS IN GROUP I ACCORDING TO INITIATING ORGANISM

Result	4-4-4	3-4-4	3-4-3	3-4-2	3-5-3	2-4-4	3-0-0	0-2-0	Un- class- ified	Total No of cases
<i>Staphylococcus aureus</i>	4	1	1	2	1	1	1	1	2	8
<i>Hemolytic streptococcus</i>	4	1	1	2	1	1	1	1	2	4
<i>Non hemolytic streptococcus</i>	1	1	1	1	1	1	1	1	2	3
<i>Streptococcus and staphylococcus</i>	3	1	1	1	1	1	1	1	2	3
<i>Pneumococcus</i>	3	1	1	1	1	1	1	1	2	3
<i>Bacillus pyoverdans</i>	1	1	1	1	1	1	1	1	2	1

TABLE IV—END RESULTS IN GROUP I ACCORDING TO DURATION OF SYMPTOMS BEFORE OPERATION

Duration of symptoms in days	4-4-4	3-4-4	3-4-3	3-4-2	3-5-3	2-4-4	3-0-0	0-2-0	Un- class- ified	Total No of cases
1	1	1	1	1	1	1	1	1	2	8
2	1	1	1	1	1	1	1	1	2	4
3	1	1	1	1	1	1	1	1	2	3
4	1	1	1	1	1	1	1	1	2	3
5	1	1	1	1	1	1	1	1	2	3
6	1	1	1	1	1	1	1	1	2	3
7	1	1	1	1	1	1	1	1	2	3
8	1	1	1	1	1	1	1	1	2	3
9	1	1	1	1	1	1	1	1	2	3
10	1	1	1	1	1	1	1	1	2	3
11	1	1	1	1	1	1	1	1	2	3
12	1	1	1	1	1	1	1	1	2	3
13	1	1	1	1	1	1	1	1	2	3
14	1	1	1	1	1	1	1	1	2	3
15	1	1	1	1	1	1	1	1	2	3
16	1	1	1	1	1	1	1	1	2	3
17	1	1	1	1	1	1	1	1	2	3
18	1	1	1	1	1	1	1	1	2	3
19	1	1	1	1	1	1	1	1	2	3
20	1	1	1	1	1	1	1	1	2	3
21	1	1	1	1	1	1	1	1	2	3
22	1	1	1	1	1	1	1	1	2	3
23	1	1	1	1	1	1	1	1	2	3
24	1	1	1	1	1	1	1	1	2	3
25 plus	1	1	1	1	1	1	1	1	2	3

In one case the duration of symptoms was unknown

The drains must be soft, they must not be large enough to cause pressure necrosis, and they should be withdrawn as rapidly after operation as the subsiding of the infection will permit.

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and the attitude of the writers toward the disease is gloomy

3 The idea of attempting to preserve the function of a purulent joint is relatively recent and is not yet widespread

4 Thirty six cases of acute suppurative arthritis are presented, in which operations had been performed at the New York Orthopaedic Dispensary and Hospital during the past 15 years

5 Twenty two of these cases were bacteriologically proved and uncomplicated by bone infection The end results in this group were 12 or 54 per cent were excellent anatomically, symptomatically, and functionally, 5, or 23 per cent, were good 1 was fair and 2 or 9 per cent, were poor

6 Four cases were similar to the above except that they were not bacteriologically proved Results in this group were, 2 excellent and 2 poor

7 Ten cases were complicated by infection of the bone at the joint The results in these were much worse than in the above groups there being no excellent results and five failures due to ankylosis or dislocation

8 It is thus seen that the presence of bone destruction greatly increases the seriousness of this disease

9 The average follow up period was 6 5 years The average age at operation was 6 5 years There were thrice as many males as females The hip was involved in 22 cases the knee in 8 there were 3 elbows 2 ankles 1 shoulder

10 The staphylococcus was the infecting organism in 12 cases streptococcus in 11 mixed staphylococcus and streptococcus in 4, pneumococcus in 3 mixed streptococcus and Bacillus coli in 1 Bacillus pyocyaneus in 1

11 In general the best results were obtained in those joints which had early diagnosis and early evacuation of the pus

12 Active postoperative motion cannot be depended upon as the sole method of continuous evacuation of pus from an infected joint, because of the extreme pain and the usually tender age of the patient

13 In obtaining efficient continued drainage in this series of cases the most useful adjuncts to arthrotomy were found to be the insertion of soft rubber drains into the joint cavity and gentle passive motion immediately following the operation The importance of active motion after arthrotomy cannot be overestimated, and this was substituted for passive motion as soon as the patients could stand it

14 There were no deaths, no amputations, no septicæmias, ankylosis occurred only in 4 cases

in which bone destruction at the hip had occurred before operation

15 The prognosis for function in acute suppurative arthritis is good if the diagnosis is made early and this is promptly followed by arthrotomy and drainage It is poor if treatment is delayed until bone destruction has taken place

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## SUBTOTAL VERSUS TOTAL HYSTERECTOMY

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THE recent literature concerning hysterectomy for non malignant pelvic conditions shows a definite trend of opinion toward the employment of the total rather than the subtotal or supravaginal operation. This tendency seems to be due largely to emphasis on the possibility of subsequent development of cancer in the stump of the cervix uteri, though the more radical operation has also been recommended for the relief of cervicitis alone. As apparent justification for this position, a majority of the reports seen by us during the last 5 years show very little or even no greater mortality with total than with subtotal hysterectomy (Table I).

TABLE I—MORTALITY IN TOTAL VERSUS SUBTOTAL HYSTERECTOMY

	Subtotal hysterectomy		Total hysterectomy	
	Number	Mortality per cent	Number	Mortality per cent
Masson	717	1.8	259	1.3
Nelson	122	3.2	476	2.0
Fullerton and Faulkner	609	4.4	1,078	4.1
Burch and Burch	166	4.2	32	3.1
Mayo and Mayo	3,085	1.2	1,558	1.8
Greenhall	1,857	4.47	551	4.72
Read and Bill	1,759	2.1	605	3.1
Total	7,795	2.6	4,559	3.0

From the figures in Table I we can calculate 7,795 subtotals with 199 deaths or a mortality rate of 2.6 per cent, and 4,559 totals with 139 deaths or a mortality of 3.0 per cent. However, a critical review of the reports containing these series makes the figures less convincing. The series reported by Mayo and Mayo refers to the hysterectomies for fibroid only which were done at the Mayo Clinic from 1916 to 1929 and includes some of Masson's cases. They believe that in their figures the difference in favor of the subtotal operation may be apparent only because of sampling or the occurrence of grave risks among those selected for the total removal. They further believe that the latter reason also explains the higher mortality for total hysterectomy in other reports. Von Graff expressed the same opinion.

Such reasoning is so contrary to usual surgical practice that we are at a loss to explain it, unless the reference is to operation in the presence of infection of the cervix or of malignancy. In fact, it is not uncommon, when a total hysterectomy seems desirable, to be forced to resort to the less formidable subtotal operation on account of poor condition of the patient before or during operation or because of technical difficulties. Read and Bill conclude that subtotal hysterectomy carries less risk "in spite of the fact that it includes those patients who are poor operative risks." Nelson gives as partial explanation for the higher mortality with the supravaginal operation in his series that "it has often been done in poor risks." Moreover, in regard to peritonitis he makes the interesting observation that the danger should be as great in cutting through the infected cervix as through the wall of the vagina which "is more accessible and can be more easily sterilized than the cervix." The exceptionally high mortality for the subtotal operation in the report by Fullerton and Faulkner is unexplained. Similar figures in Greenhill's series were due to the unusually high mortality (8.9 per cent) with subtotal hysterectomy plus bilateral salpingectomy in cases with advanced tubal and ovarian infections involving adhesions to adjoining structures. Where hysterectomy alone was done, the mortality was 5.5 per cent for total and only 0.8 per cent for subtotal. The series of Burch and Burch contains too few totals to be of much significance. With the exception of Fullerton and Faulkner, all authors who mention morbidity and complications show them to be more frequent with total hysterectomy. Fullerton and Faulkner give their incidence of shock, injured viscera, hemorrhage, etc. as 5.5 per cent for total and 6 per cent for subtotal hysterectomies, the difference (0.5 per cent) in favor of total being reversed if cardiac complications are not included. It might be said also that some, at least, of these statistics were derived from special clinics and therefore cannot be used as a general guide in private practice.

We have undertaken a study of abdominal hysterectomies done at Harper Hospital with the expectation that the figures from this large general hospital might fairly represent the relative results to be expected from the two types of operation in private practice. Our study included

## SIDDAL, MACK SUBTOTAL VERSUS TOTAL HYSTERECTOMY

cases, we consider these figures as merely suggestive

It has been stated in the literature that the apparent advantages in mortality of subtotal over total hysterectomy varied with the skill and experience of the operator, the inference being that the more experienced operators could obtain as low mortality rates with total as subtotal hysterectomy. To test this assertion we investigated the whole group of 235 total operations, and for comparison the 488 subtotals done in 1929 and 1931. The years 1929 and 1931 were selected as being at neither extreme of time and therefore probably representative, the mortality rate, moreover, for these periods being the same as for the whole group of subtotal hysterectomies. We found that the 693 operations (total and subtotal) had been done by 46 different gynecologists and general surgeons of greatly different experience as evidenced by the number of hysterectomies performed by each. Two operators did 50 or more during these periods, five, 25 or more and less than 50, thirty-eight, less than 25. Table III shows the comparative mortality rates for these groups. A separate classification was given the clinic cases as these were in large part operated upon by a series of five residents, though under the supervision and usually with the assistance of a senior attending gynecologist. Besides demonstrating the value of experience, this table shows a lower mortality for subtotal hysterectomy in every division, and except in the clinic cases the difference is striking.

TABLE III—COMPARATIVE MORTALITY OF DIFFERENT OPERATORS

All cases	Total	Subtotal	Cases per operator
Mortality per cent	Mortality per cent	Mortality per cent	Mortality per cent
50 plus	4.3	0.7	50 plus
25 to 49	4.5	0.9	25 to 49
10 to 24	11.9	4.8	10 to 24
5 to 9	5.4	4.8	5 to 9
1 to 4	6.6	4.8	1 to 4
Clinic	5.1	4.8	Clinic

The immediate causes of death with the actual numbers for both subtotal and total hysterectomy are shown in Table IV. In general these figures confirm those usually given except for the higher incidence of infection and peritonitis in our series. The percentage occurrence of these causes was approximately 57 per cent of the subtotal and 73 per cent of the total hysterectomy deaths, or mortality rates of 1.5 per cent and 4.7 per cent, respectively, from these causes alone. Embolus caused deaths in 0.5 per cent with the subtotal

the 5 years from January, 1928, through December, 1932, during which time there were 1,379 abdominal hysterectomies for benign gynecological conditions. This is exclusive of all cases of cervical carcinoma regardless of type of operation. To make the conditions under which the two operations were performed as nearly comparable as possible, we further excluded operations done in the presence of malignancy of the body of the uterus and of the adnexa. Cesarean sections or ruptured uteri followed by hysterectomy were also not included. It is noteworthy, however, that the inclusion of these eliminated cases (80) would have changed the mortality figures only a fraction of one per cent. Of the 1,376 operations, 1,141 were subtotal hysterectomies with 30 deaths and 235 total with 15 deaths. The combined mortality rate was 3.3 per cent.

TABLE II—HARPER HOSPITAL SERIES SHOWING MORTALITY

Year	Subtotal	Total	Number	Per cent	Mortality Per cent
1928	241	241	20	8.3	8.3
1929	66	66	21.5	32.3	32.3
1930	217	217	12.5	5.7	5.7
1931	340	340	13.4	3.9	3.9
1932	210	210	14	6.7	6.7
Subtotal	1,141	1,141	205	18.0	18.0
Total	205	205	16.0	7.8	7.8
Subtotal	1,379	1,379	26	1.9	1.9
Total	26	26	4	0.4	0.4

Table II gives the number of both operations with their mortality rates for each year. It also shows the yearly percentages of total hysterectomies. The mortality rates for the subtotal operation have remained at a fairly constant level whereas those for the total have tended to diminish. In addition, it is seen that the years with the lower percentages of total hysterectomy had a somewhat lower mortality rate for that operation. On the assumption that possibly the lower rates were due to a tendency to elect the subtotal operation for poor risks, the years 1929 and 1931 were studied. In 1929, the total operation was done on 11 poor risks (hemoglobin below 70 per cent, cardiac disease, nephritis, diabetes), and in 1931 on 10. The subtotal operation was performed on 32 in poor condition in 1929 and 38 in 1931. Because of the small yearly number of

and 0.8 per cent with the total operation. Shock with myocardial failure resulted fatally in 0.4 per cent and 0.8 per cent of the 1,141 subtotal and 235 total hysterectomies. These statistics show that the usual causes of death (peritonitis, embolus, and shock) were common to both types of operation, but occurred to a greater degree in total hysterectomy.

TABLE IV—IMMEDIATE CAUSES OF DEATH

	Peritonitis and infection	Emboli	Shock and myocardial failure	Diabetes	Pneumonia	Total
Deaths in 1,141 subtotal hysterectomies	17	6	5	1	1	30
Deaths in 235 total hysterectomies	11	3	2	0	0	15

The influence of accessory procedures at the time of operation was studied in the groups mentioned in Table IV, viz., the 235 totals for all 5 years as compared to the 458 subtotal hysterectomies for the years 1929 and 1931. Removal of the uterus without the adnexa resulted in 1 death in 60 totals and 5 deaths in 174 subtotals—a mortality rate of 1.5 per cent and 2.9 per cent, respectively. With salpingectomy or salpingo-oophorectomy the results were quite different, for with the 147 totals there were 13 deaths (8.8 per cent) and with the 247 subtotals there were 7 deaths (2.8 per cent). Of the 147 totals with salpingectomy or salpingo-oophorectomy there were 80 with definite clinical and laboratory evidence of pelvic inflammation such as extensive adhesions or subacute or chronic salpingitis. The mortality was 10 per cent. In 67 cases with no note of pelvic inflammation there was a mortality of 7.4 per cent. Among the 247 subtotal hysterectomies with the same accessory procedures there were 105 showing pelvic inflammation and 82 without the mortality being 3 and 2.4 per cent, respectively. It is probable that many cases designated by us as without pelvic inflammation were actually complicated by the condition although it was not so stated in the histories. It is quite evident that the higher mortality of hysterectomy plus salpingectomy and salpingo-oophorectomy was due in part, at least, to difficulties encountered because of pelvic inflammation as was noted also by Greenhill. This observation is supported by the mortality rates of subtotal and total hysterectomy for fibroid with and without pelvic inflammation as shown in Table V.

Of other accessory procedures, appendectomy was the most frequent, being done in 83, or 35.3

TABLE V—MORTALITY WITH AND WITHOUT PELVIC INFLAMMATION

	Subtotal Mortality per cent	Total Mortality per cent
Hysterectomy for fibroids without pelvic inflammation	2.8	3.8
Hysterectomy for fibroids with pelvic inflammation	3.1	19.9
With and without pelvic inflammation	2.9	7.0

per cent, of the totals and in 220, or 48 per cent, of the subtotals. Three of the patients in whom total hysterectomy plus appendectomy were done died, a mortality rate of 3.6 per cent as compared to 6.4 per cent for the whole group. There were no deaths among the subtotal cases with appendectomy. We believe these results should not necessarily be interpreted as indicating that removal of the appendix added no danger to hysterectomy, but rather that appendectomy was reserved in general for the more favorable cases. Supporting the latter possibility, and without taking into account technical difficulties, etc., is the fact that among the totals with appendectomy there were 8.4 per cent poor or questionable surgical risks (hemoglobin below 70 per cent, cardiac disease, nephritis, diabetes) as compared to 19.1 per cent for those without appendectomy. Among the subtotal hysterectomies plus appendectomy there were 10.9 per cent poor risks as compared to 19 per cent for the remainder of those done in 1929 and 1931. Other accessory operations such as perineorrhaphy, colporrhaphy, cholecystectomy, and herniorrhaphy were performed in an additional 21 of the totals and 35 of the subtotals—with 1 death among the totals.

## DISCUSSION

Our investigations indicate a definitely higher mortality for total hysterectomy than for the subtotal operation. Furthermore, we believe that statements in the literature to the contrary are not convincing when the data on which they are based are analyzed. On the other hand, it seems that when hysterectomy is to be undertaken and there is also a definite indication for removal of the cervix the more radical operation is not unduly dangerous in the best operative risks.

The actual incidence of carcinoma developing in the cervix after subtotal hysterectomy is not known but the possibility is worthy of consideration. Polak estimated the occurrence at 2 per cent, a figure which would possibly justify the frequent employment of total operation. But, this is far higher than that stated by other

cluding malignancy, cesarean section followed by removal of the uterus, and ruptured uterus) of which 1,141 were subtotal and 235 total with mortality rates of 2.6 per cent and 6.4 per cent, respectively. There was a tendency for the total hysterectomy mortality to be lower in the years with a relatively smaller proportion of the more radical operation. All groups made on the basis of surgical experience of the operator (number of operations per operator) showed an advantage in favor of subtotal hysterectomy more dangerous and explained in part, at least, the higher mortality of hysterectomy with removal of the uterus. With accessory operations such as appendectomy and perineorrhaphy, the lower mortality was apparently associated with a selection of the better risks for these additional procedures. The danger of carcinoma developing in the stump of the cervix after subtotal hysterectomy is seemingly not sufficiently great to justify the additional risk of the total operation in any but a small proportion of cases. Other less dangerous procedures should be more frequently recommended.

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## SUMMARY

Von Graef quotes Hochmann as giving 0.27 per cent Mayo and Mayo reported 99 cases seen at the Mayo clinic from January, 1910, to July, 1920, only 15 of these, however, being women who had been operated on there. They are due to coming out the cervical canal from above but it does not remove the usual site of cervicitis and carcinoma of the cervix—the region of the external os. Of much greater value, we think, is their suggestion that following subtotal hysterectomy the cervix be removed later from below or that enucleation of the cervical canal or cauterization be carried out. In several instances where total hysterectomy seemed indicated but was not done on account of the patient's condition, one of us has later removed the stump of the cervix without difficulty, but this has the obvious objection of additional hospitalization. In cases in which the cervix is torn and infected but not sufficiently so to make its removal imperative, thorough cauterization or conization under anesthesia before the abdominal incision is made should accomplish much in preventing carcinoma in the cervical stump. Moreover, the rare, very early, and therefore local and unrecognized carcinoma would almost certainly be destroyed. In our series the operation records of the 458 subtotally done in 1929 and 1931 showed only 10 of these accessory operations on the cervix, though probably some cauterizations were done later because of persistent leucorrhoea.

Although there is a definite tendency in the recent literature to ascribe to total hysterectomy a mortality comparable with that of the subtotal operation, a critical study of the reports leaves one far from convinced. In our 5 year series there were 1,376 abdominal hysterectomies (ex-

## DIVERTICULA OF THE STOMACH

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**A**NATOMICALLY, the term, diverticulum, is applied to a blind tubular process and pathologically, to any malformation having this character. Alkerlund described gastric diverticula as rounded pocket shaped or bag shaped protrusions from the lumen of the stomach. Thus, broadly speaking, the term includes not only true diverticula whether congenital or acquired, but also diverticular formations resulting from intrinsic lesions of the gastric wall, such as ulcer or neoplasm. In this paper only true diverticula will be considered in detail.

Diverticula occur in the stomach less commonly than in other portions of the alimentary tract with the possible exception of the jejunoileal region. Fraser stated that these lesions occur in the different parts of the alimentary tract in the following order of frequency: colon, rectum, duodenum, pharynx and esophagus, stomach, jejunoileum. The statistics of Larimore and Graham are in accord with this statement. In a series of 5,446 examinations of the digestive tract with the opaque meal they found 105 diverticula: 71 were in the colon, 19 in the duodenum, 9 in the esophagus, 3 in the stomach and 3 in the jejunum.

The first case of diverticulum of the stomach was reported by Helmont in 1804. Since that time we have found 108 cases either mentioned or reported in detail in the literature. As might be expected most of these have been reported since roentgenological examination has become available in diagnosis. Many of the cases reported have not been confirmed at operation or necropsy. This detracts materially from the reliability of the reports because of the difficulty in distinguishing roentgenologically true gastric diverticula from false diverticular formations. Our series includes 14 proved cases of diverticula of the stomach.

Four of the specimens of diverticula were obtained at necropsy and 10 were removed at operation. Diverticula of the stomach have been diagnosed roentgenologically in 25 cases at the Mayo Clinic since 1926. In 6 cases of the group, exploratory operations revealed only 2 to be true diverticula; in the 4 others, diverticular pro-

trusions were found to be due to perforating peptic ulcer or to carcinoma. The 19 remaining cases, in which diagnosis was made roentgenologically but not proved or disproved at operation or necropsy, are not included because of the frequent confusion in the roentgenologic diagnosis of these lesions.

## CLASSIFICATION

Diverticula of the digestive tract have been variously classified as congenital, or true, acquired or false, and pulsion or traction types. True (congenital) diverticula have been considered to have intact muscular and mucosal layers whereas false (acquired) diverticula have been considered to be those diverticular formations in which one or more of the mural layers are absent. The terms 'pulsion' and 'traction' are self explanatory and have been used frequently in connection with true and false diverticula. Kausch pointed out that the terms congenital and true' and acquired' and false' are not always synonymous. Brandes substantiated this statement by reporting a case of an acquired diverticulum in which all layers of the wall of the sac were present.

It is thus evident that there is much confusion and some inaccuracy in the classification of these abnormalities. In order to simplify the subject of gastric diverticula, we suggest the following subdivisions:

1. *True diverticula*. Those in which the pouch includes all coats of the gastric wall without definite evidence that organic disease was the causative factor. Such diverticula probably are congenital (Fig. 1).

2. *Acquired true diverticula*. In these all coats of the gastric wall are present although there may be some thinning, and there is evidence that some disease was instrumental in causing the pouching.

(a) *Pulsion type diverticula* result from intra gastric pressure which is probably localized.

(b) *Traction type diverticula* are incidental to extragastric adhesions (Fig. 2).

3. *False diverticula or diverticular formations*. In these there is a break in the gastric wall resulting from disease (Fig. 3).

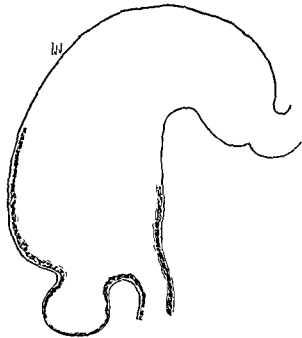


Fig. 1 True diverticulum at the cardiac part of the stomach. The mural elements are intact but are thinned out



Fig. 2 Acquired true diverticulum of traction type. Mural layers of the wall of the sac are present and there is some thinning at the site of the adhesive band

Despite views to the contrary, it seems to us that the weight of evidence favors a congenital basis for this group of gastric diverticula. Diverticula are not uncommon in lower animals, especially in the pig. The tip of the fundus in this animal normally develops as a diverticulum. The stomach of South America has a cardiac diverticulum normally (Alvarez). However, the fact that this animal virtually lives in an inverted posture might be interpreted by exponents of the idea as adding weight to the hypothesis that diverticula are acquired by pulsion. The beaver has a projection of the pylorus at the greater curvature of the stomach. The fish *Lophius piscatorius* or angler, has protrusions from the pylorus at each curvature and the American aquatic herpetivorous mammal, the manatee, has three diverticular compartments, namely, at the pars media, on the greater end at the cardia (Huntington). All mammals, as well as certain forms of aquatic life, such as the *Aryz. fonsca aquatica*, *Asterias rubens*, and others, have similar gastric compartments (Bueschli).

In attempting to explain the occurrence of diverticula of the stomach in man embryologically, Kallbetsch stated that the fundus of the stomach of man develops as a pouch on the outer side of the cardia. He expressed the belief that, in congenital diverticula, another smaller pouch develops and remains connected with the stomach by a narrow neck. This hypothesis would

True diverticula. The etiology of true diverticula is unknown. The question even has been raised as to whether a truly congenital type exists at all. Zahn went so far as to state that no diverticula reported up to 1899 were congenital. Laurell and others expressed the belief that these true diverticula are of the pulsion type and are caused by intra abdominal pressure among persons with a lax abdominal wall. That this is the true explanation is doubtful, since true diverticula have occurred in young, muscular adults and in children. Gile reported a case of a girl, aged 7, with a diverticulum, and Sinclair one of a month's old infant, both being confirmed at operation.

Furthermore, as has been demonstrated by Gianturco and others, intragastric pressure is ordinarily quite low. At the cardia, where most diverticula occur, the pressure is lowest, ranging from 5 to 2 centimeters of water. Alvarez has distinguished the fresh stomachs of cats and dogs under pressures much greater than those occurring physiologically without producing diverticula. The objection may be raised that this experiment was inadequate, and that continued or repeated pressure would be necessary for the development of diverticula. On the other hand, Iaser consistently produced multiple diverticula in the jejunum by briefly distending this part of the bowel, he thus confirmed his belief that jejunal lesions could be acquired.

#### HYPOTHESES AS TO FORMATION

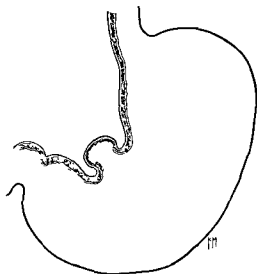


Fig 3 False diverticulum due to weakening of the gastric wall by ulcer

explain only those diverticula that occur at the cardia. It is interesting to note that diverticula of the pyloric region have not infrequently been found in association with aberrant pancreatic tissue. Nauwerck, Falconer, Weischelbaum, Kolb, Wagner and Gegenbauer found pancreatic tissue in such diverticula. Gile demonstrated heteroplastic colonic mucosa in a gastric diverticulum and pancreatic tissue adjacent to it.

Anatomically, there is thinning of the circular and oblique muscular fibers at the cardia. Large vessels that enter the gastric wall in this region also contribute to the muscular weakness and make it a site of lowered resistance. Thorel and Zahn believed that this part of the stomach was subject to the greatest strain as food passed along the *Magenstrasse*.

In view of the fact that diverticula of the type under consideration have been found in all regions of the stomach and almost uniformly present muscular and mucosal elements which are thin, it seems possible that these diverticula may occur as a result of a congenital localized weakness of the gastric wall. The natural anatomical weakness at the cardia, and the frequent presence of pancreatic tissue at the pylorus, could account for the relative frequency of diverticula at these sites. On the other hand, the thinness of the wall of the sac may be secondary to pressure of gastric contents accumulating in the diverticulum. Such a hypothesis would fit in with the conception that diverticula, as such, exist as vestigial phenomena. It would at least seem reasonable to assume that congenital, anomalous conditions precede develop-

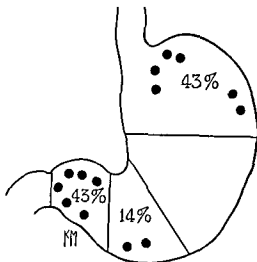


Fig 4 The situation of the diverticula in our series of cases

ment of such an abnormality, if it does not already exist at birth.

**Acquired true diverticula.** The etiology of this type of diverticulum is usually obvious. Adhesions to the gall bladder, pancreas and spleen are probably the more common factors producing traction. Jones reported a case in which the gastric wall was adherent to the gastroduodenal ligament and colon. Kalbfleisch expressed the belief that this case was probably one of ulcer. Chutro described a case of diverticulum with adhesions to the abdominal wall at the site of a hernia. Von Hanse reported another case with adhesions to an epigastric tumor. A pulsion diverticulum was caused by a trichobezoar in a case reported by Schulten.

**Acquired false diverticula.** The gastric wall may be weakened by inflammatory reaction, ulceration, or by neoplasm. It is conceivable that intra-gastric pressure or progressive ulcerating processes could produce pouching at the site involved.

#### REVIEW OF MATERIAL IN THIS SERIES

**Incidence.** Ten specimens in our group were removed in 10 of 11,234 consecutive exploratory operations on the stomach or 1 in 1,235. Four specimens were obtained in the course of 3,662 routine postmortem examinations, or 1 in 917. Twenty-five roentgenologic diagnoses of gastric diverticulum were made in the course of 91,532 routine roentgenologic examinations of the stomach at the clinic since 1926. As has already been mentioned, many of these were probably not true diverticula.



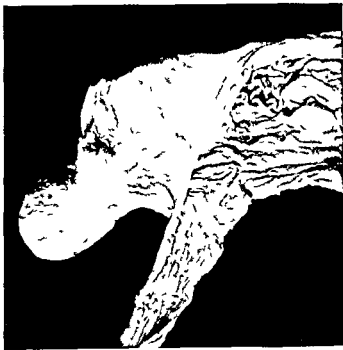


Fig. 6 True diverticulum at the cardiac end of the stomach. Specimen obtained at necropsy with esophagus intact.

of our cases (Figs 5, 6, 7, 8). Acquired, or so called false diverticula, may have a deficiency of the mucosal layer or of one or more muscular layers, or both, and the serosa often gives evidence of adhesions to adjacent viscera.

*Associated gastric disease.* Associated gastric disease was found in 4 of our 14 cases (30 per cent), in 2 cases, there were ulcers adjacent to the diverticula (in 1 case at the cardia, and in the other, at the pylorus), in 1, an adenomyoma in the diverticulum and a duodenal ulcer, and in the remaining case, a sarcoma in the wall of the diverticulum. What part, if any, the adenomyoma and the sarcoma played in the development of the



Fig. 8 Wall of normal stomach adjacent to diverticulum  $\times 6\frac{1}{2}$ .



Fig. 5 True cardiac diverticulum specimen obtained at necropsy.

*Ages.* The ages of the patients in this series ranged from 25 to 59 years, 9 were 40 years of age or older and 5 were from 25 to 40 years of age. The average age was 42 years.

*Sex.* Diverticula occurred about equally often in either sex, 6 of the patients were men and 8,

*Situation.* The situation of diverticula in cases reported in the literature varies, but they seem to occur most often in the cardia, just below the esophageal junction on the posterior wall and usually nearer the lesser than the greater curvature. According to reports they occur next most often at the pylorus, near one or the other curvatures. In our series of proved cases, 6 diverticula were found immediately adjacent to the pylorus, 6 at the cardia, and 2, some distance from the pylorus on the posterior wall (Fig. 4).

*Pathologic findings.* Diverticula of the stomach in proved cases reported heretofore have varied in diameter from 1 to 5 centimeters. In our group the smallest diverticulum was 1 centimeter in diameter and the largest, 7.5 centimeters (3 inches). The neck of the sac is usually narrow and may or may not be thickened. Grossly, the mucosal and serosal surfaces appear intact. Microscopic examination of sections of the wall of the sac reveal the presence of the mucosal and muscular layers, but these are thinned out. Pancreatic tissue was not found in the diverticulum in any



Fig. 7 Section of wall of true diverticulum. All layers are intact but are thinned out  $\times 6\frac{1}{2}$ .

diverticulum, is problematic. Cleve, Puskepellies, and Nauck considered that such lesions developed in pre existing diverticula, whereas Bell and Golden doubted whether these should be classed as true diverticula. The literature contains reports of a number of cases with associated disease similar to those in our group. Cleve reported a myoma in a diverticulum, Sandstrom a diverticulum with a benign adenoma, and C. H. Mayo, von Hansemann, Miller, and Mellon, and others, cancerous or precancerous changes in diverticula.

*Two or more diverticula in the gastro intestinal tract.* Of the 14 cases included in this report, in 2, demonstrable diverticula were present elsewhere in the digestive tract. In 1 case, multiple diverticula in the colon were found and in another a duodenal diverticulum was found.

#### SYMPTOMS

The general opinion of writers on the subject is that most diverticula of the stomach cause no definite symptoms and are usually not of clinical importance. However, some cases have been reported in which there was epigastric distress, positive roentgenologic evidence and apparent relief following surgical treatment.

In 1 case of our group the patient complained of haematemesis, and blood clots were found in the diverticulum. Definite evidence of blood dyscrasia developed later. In 4 cases part or all of the symptoms may have been attributable to the diverticulum. In 4 the complaint was accounted for by associated gastric or duodenal ulcers and in 1 a sarcoma may have been responsible for some of the symptoms. Thus in 10 of the 14 cases (71 per cent) symptoms could not be attributed to the diverticulum *per se*. In the 4 cases (excluding the one with haemorrhage) in which the symptoms may have been related to the diverticula epigastric pain was present, which might or might not be relieved or aggravated by food; in 2 vomiting had occurred on several occasions (in 1 case probably due to cardiospasm), and in 3 epigastric tenderness was present.

#### DIAGNOSIS

The recognition of a true gastric diverticulum without the aid of the roentgenogram is impossible, as there is no characteristic clinical syndrome (Fig. 9). Even the roentgenologic findings are difficult to interpret as is evident from the fact that in 4 of 6 of our cases in which the diagnosis had been diverticula, these diverticula were found at exploration to be false sacs due to malignant disease or to perforating ulcer. The 2 cases in which true diverticula were found were the only

cases in our group of proved cases in which the pre operative diagnosis was correct. Both of these diverticula were at the cardia. However, one is probably justified in making a diagnosis of diverticulum when the roentgenologic findings are consistent and the patient has epigastric distress which is not attributable to other disease.

A number of writers stress the difficulty of roentgenologic diagnosis. Sandstrom said that the diagnosis depends on a niche like opaque spot surrounded by a defect in the contrast shadow the appearance of which is also typical of ulceration with surrounding infiltration. Pendergrass outlined the differential diagnosis of diverticulum and hernia through the oesophageal hiatus. He stated that hernias are best seen with the patient in the recumbent Trendelenburg position, and that they are larger during inspiration and smaller during expiration because of variations in intra abdominal pressure. A gastric diverticulum, on the other hand, does not reveal these changes.

#### COMPLICATIONS

A complication occurred in but one (7.1 per cent) of our proved cases, in this instance being haemorrhage. This case has previously been reported by Sutherland. Haemorrhage also has been reported by Brown, Akerlund, Gile, and by Sinclair.

#### TREATMENT

The treatment in 10 cases of our series was surgical. The diverticula were removed by local excision, by sleeve resection of the stomach, or by pylorotomy. When gastric or duodenal lesions were associated with diverticula, the surgical procedures were modified according to the type of disease that obtained. The indication for treatment of a diverticulum in the upper portion of the stomach rests on a positive roentgenologic diagnosis plus the presence of epigastric distress not referable to other disease.

Bell and Golden felt that postural drainage should be tried in cases of diverticula at the cardia as carcinoma has never been reported in this group. They believed that surgery should be performed in all cases in which the lower two thirds of the stomach was involved, because of the possibility of associated malignant disease and the frequently mistaken roentgenologic diagnosis of diverticula in this region. In the light of the present study, we are led to concur in this opinion. The consensus of opinion favors excision of the sac as the procedure of choice, although inversion of the diverticulum, gastro-enterostomy, and gastric resection have been performed in some instances.

REPORTS OF CASES  
SURGICAL

**CASE 1** A man, 36 years of age, came to the clinic because of stomach trouble of 3 to 4 years' duration. He complained of a "hot spot" in the upper portion of his abdomen that had been more or less constantly present but had never been aggravated by heavy foods. He made the statement that it felt as though a sac were present near the entrance of the stomach because there was a dull pain in this region similar to that caused by food packed in the socket of a tooth. Epigastric tenderness was present.

Analysis of gastric contents revealed a total acidity of 60, free hydrochloric acid of 40, and a total quantity of 140 cubic centimeters. The roentgenologic diagnosis was diverticulum of the cardiac end of the stomach. Other findings were irrelevant.

Exploration revealed a diverticulum at the cardia immediately below the esophagus passing to the left and along the fundus of the stomach. The diverticulum was excised. The pathologist reported that the diverticulum was 5 by 4 centimeters in diameter, with thinned out muscular and mucosal layers.

**CASE 2** A woman, 28 years of age complained of abdominal distress of 12 years' duration. She stated that the region of maximal distress was situated to the left of, and above, the umbilicus although pains elsewhere in the abdomen were not infrequent. Belching and alkalies were said to have given relief, whereas food had had no effect on her symptoms unless at times to aggravate them. She occasionally had awakened at night with epigastric pain that usually had radiated to the sternum. She presented the multiple, bizarre complaints so often encountered in neurotic persons. General physical examination gave negative results.

Analysis of gastric contents revealed a total acidity of 44, free hydrochloric acid of 32, and a total quantity of 100 cubic centimeters. The roentgenologic diagnosis was diverticulum on the posterior wall of the cardia.

At operation, a diverticulum was found on the posterior wall of the stomach at the cardia and also an ulcer next to the pylorus. The lesions were excised. The pathologist reported that the diverticulum was 2.5 centimeters in diameter, with an opening into the stomach 1 centimeter wide.

**CASE 3** A man, 43 years of age complained of a dull, aching pain in the upper portion of his abdomen, of which he had been aware for 1 year. The pain had been constant gastric tenderness had also been present.

Analysis of gastric contents revealed a total acidity of 70, free hydrochloric acid of 50, and a total quantity of 175 cubic centimeters. The roentgenologic diagnosis was pyloric ulcer.

At exploration, a diverticulum, 4 centimeters in diameter was found on the greater curvature and removed by resection of the pyloric third of the stomach. A posterior cause of stomach trouble during the previous 4 years. She complained of pain in the epigastrium following a heavy meal, which had been relieved by emesis and masses of the abdomen and partially alleviated by taking soda. Slight analysis of gastric contents revealed a total acidity of 40, free hydrochloric acid of 32, and a total quantity of 35 cubic centimeters. The roentgenologic diagnosis was diverticulum.

**CASE 4** A woman, aged 30 years, entered the clinic because of stomach trouble during the previous 4 years. She complained of pain in the epigastrium following a heavy meal, which had been relieved by emesis and masses of the abdomen and partially alleviated by taking soda. Slight analysis of gastric contents revealed a total acidity of 40, free hydrochloric acid of 32, and a total quantity of 35 cubic centimeters. The roentgenologic diagnosis was diverticulum.

At exploration, a diverticulum, 4 centimeters in diameter was found on the greater curvature and removed by resection of the pyloric third of the stomach. A posterior cause of stomach trouble during the previous 4 years. She complained of pain in the epigastrium following a heavy meal, which had been relieved by emesis and masses of the abdomen and partially alleviated by taking soda. Slight analysis of gastric contents revealed a total acidity of 40, free hydrochloric acid of 32, and a total quantity of 35 cubic centimeters. The roentgenologic diagnosis was diverticulum.

**CASE 5** A woman, 26 years of age, came to the clinic because of dysphagia and epigastric substernal pain that had been present for 10 months. She also had had pain in the epigastrium from 1 to 2 hours after meals. There had been some regurgitation at times. Dilatation of the esophagus had relieved the substernal pain, but had failed to affect the distress in the epigastrium.

Exploration revealed a diverticulum 3 inches (7.5 centimeters) deep at the lower margin of the stomach near the pylorus. The lesion was excised and the pathologist's report confirmed the diagnosis.

Eighteen years later the patient complained of symptoms referable only to cardiospasm.

**CASE 6** A man, 51 years of age, entered the clinic because of weakness, anemia, and fatty stools during the previous 6 months. Examination of the blood revealed that the concentration of hemoglobin was 43 per cent, that erythrocytes numbered 3,120,000 and leukocytes 8,000 per cubic millimeter, and that the color index was 0.7 per cent. There was a total gastric acidity of 90, free hydrochloric acid of 72, and a gastric content of 80 cubic centimeters. The roentgenologic findings were suggestive of a benign lesion at the pyloric end of the stomach.

On exploration, two diverticula containing clotted blood were found on the posterior wall of the stomach near the greater curvature and about 3 inches (7.5 centimeters) from the pylorus. The lesions were excised by sleeve resection.

Fig. 9 Diverticulum of cardia. Fluid level is evident



Definite signs of a blood dyscrasia developed later

CASE 7 A man 50 years of age complained of vague gastric intestinal disturbance not characteristic of any definite disease. Roentgenologic diagnosis was carcinoma of the stomach. A tumor on the posterior wall 2 inches (5.0 centimeters) away from the pylorus was removed. The pathologist reported that the lesion was a diverticulum 3 centimeters long with a fibrosarcoma starting in the submucosa. The patient died subsequently from extension of the malignancy.

CASE 8 A man 49 years of age was operated on because of gastro intestinal symptoms indicative of peptic ulcer. A diverticulum was found contiguous to a perforating ulcer at the pylorus. Excision and a Finney type of pyloroplasty were performed. The surgical findings were confirmed pathologically. Six years later gastro enterostomy was performed for recurrence of symptoms.

CASE 9 A woman 39 years of age was operated on because of symptoms ascribed to peptic ulcer. A duodenal ulcer was found. Adenomyoma in a diverticulum with an opening 2 centimeters in diameter also was present. The diverticulum was on the lower border of the stomach just proximal to the pylorus. Excision of the diverticulum and gastro-enterostomy were performed. The pathologist's report was confirmatory. Three months later the patient wrote that she was cured.

CASE 10 A woman 59 years of age was operated on because of symptoms indicative of peptic ulcer. A duodenal ulcer and a diverticulum 1 centimeter in diameter in the pyloric region were excised. A Billroth I anastomosis was performed. The surgical diagnosis was confirmed pathologically. One year later the patient complained of stomach trouble.

#### POSTMORTEM

CASE 11 A woman 56 years of age died following surgical drainage of an appendiceal abscess. Necropsy revealed among other lesions a large diverticulum of the cardia and diverticula of the colon.

CASE 12 A man aged 49 years died of cardiovascular renal disease. Necropsy revealed among other lesions a diverticulum 1 by 1.5 centimeters which was situated 4 centimeters from the cardia.

CASE 13 A woman 44 years of age died following hysterectomy for carcinoma of the uterus. Necropsy revealed among other lesions a diverticulum 1 by 1.5 centimeters in diameter situated 8 centimeters below the esophagus. A duodenal diverticulum also was found.

CASE 14 A woman 55 years of age died of carcinoma of the esophagus. Necropsy revealed a diverticulum of the cardia partially covered by epithelium of the esophageal type.

#### SUMMARY AND CONCLUSIONS

An effort has been made to review in some detail a relatively large group of diverticula of the stomach seen at the Mayo Clinic.

Diverticula in the stomach are rare and, to our knowledge, only 141 cases have been mentioned or reported in detail to date, including our 33 cases, 19 of which were not proved.

In 10 (74 per cent) of the 14 proved cases which we report, there were no symptoms referable to diverticulum in 4, symptoms which may have been related to diverticulum were present.

The cause of true diverticula of the stomach is not definitely known. The hypothesis that they

are congenital is plausible. The cause of the acquired types usually is obvious.

The situation of gastric diverticula in cases reported in the literature was most often at the cardia and next most often at the pylorus, although they have occurred in every portion of the stomach. In our series the diverticula were equally distributed at the cardiac and pyloric regions of the stomach.

Associated peptic disease was present in 4 of our 14 cases (30 per cent) and consisted of gastric ulcer, duodenal ulcer, adenomyoma, and sarcoma. Similar associated lesions have been reported in cases in the literature.

The diagnosis is difficult. In our series 4 of 6 pouches diagnosed roentgenologically as diverticula proved to be pouches which developed as a result of perforating ulcers or malignant lesions.

Complication occurred in only 1 of our cases and, in that instance, consisted of hemorrhage. Such hemorrhages have been reported by other writers.

In view of the fact that it is extremely difficult to ascertain with accuracy the nature of a diverticulum of the stomach, it would seem to us that with roentgenologic evidence of such a condition and the presence of indigestion, it would be safer to advise surgical exploration.

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## EDITORIALS

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### SURGERY, GYNECOLOGY AND OBSTETRICS

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JANUARY 1935

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#### IDIOPATHIC DILATATION OF THE SYSTEM OF EVACUATION

**S**URGEONS who perform operations on the sympathetic nerves to the viscera in the pelvis are becoming familiar with coexistent dilatation of the sigmoid colon and possibly rectum, the urinary bladder and the ureters. As a rule the primary object of the operator has been to relieve the symptoms of Hirschsprung's disease by sympathectomy, and the dilatation of the lower urinary tract has not been suspected. Although there is still doubt as to the exact nature of the lesion that leads to the pathological changes in the colon characteristic of Hirschsprung's disease, the present consensus is that a congenital defect in the neuromuscular mechanism of the distal part of the colon is present. The proportion of cases of idiopathic dilatation of the colon that is associated with dilatation of the lower urinary tract is still unknown, but it is high enough to direct attention to the probability, and it is likely that the routine investigation by intravenous urography of patients suffering from Hirschsprung's disease will

show the association to be common. In such cases the obstruction to the outflow of urine from the ureters and the bladder appears to result from achalasia at the ureterovesical junctures and at the internal sphincter of the bladder, respectively.

It is probably of significance that the dilated structures receive their sympathetic innervation from the same source—the superior hypogastric plexus or presacral nerve—and this view is supported by the degree of success that has attended efforts to overcome these neuromuscular obstructions by resection of the nerve. A single anatomical lesion cannot be responsible for all the cases that fall into this broad group, for indubitably the dilatation may be confined to the colon, to the ureters and bladder, to the bladder alone, or to one ureter. The pathology of the condition is even more obscure.

Of more practical moment to the surgeon is the early recognition, and if possible correction of this state of affairs. The lesions involve the structures that are concerned in the final ridding of the body of its waste products—the system of evacuation—and inefficiency of this system must sooner or later prove fatal. Sympathectomy for Hirschsprung's disease appears to be a well tried and satisfactory operation. One of the most important factors in determining its effect on the urinary tract appears to be the state of the walls of the ureters, for long continued stasis and infection of urine may lead to changes of a chronic inflammatory nature which destroy their contractility. But the whole matter is far from surgical finality.

J. R. LEARMONTH

## THE SURGICAL TREATMENT OF HYPERTENSION

ONE of the latest developments in the field of surgery of the sympathetic nervous system is the treatment of

hypertension. Secondary forms of hypertension, such as those associated with nephritis and arteriosclerosis, as well as the paroxysmal form associated with suprarenal tumors, are not included in the group to be considered for this type of surgery.

The type of hypertension that has responded to operations on the sympathetic nervous system is the primary or constitutional form which occurs among comparatively young people, is progressive in spite of medical treatment, and carries a prognosis comparable to that of malignant neoplasms. This severe type of essential hypertension may be designated as the malignant type. Because no definite etiological factors have been found, it has been assumed that a constitutional neurogenic abnormality plays an important part in the disease. Following this assumption, and because vasospastic diseases which are due to neurogenic imbalance have been relieved by sympathetic ganglionectomy, operations on the sympathetic nervous system have been carried out in an attempt to relieve hypertension.

There is close parallelism between the disturbed vasospastic mechanism of Raynaud's disease and that of primary hypertension. In both conditions hyperactivity of the vasomotor center in the brain is believed to be at fault. Since surgical interruption of the vasomotor fibers to the extremities relieves the symptoms of Raynaud's disease, it is rational to believe that interruption of the vasomotor nerves to a large portion of the vasculature would have a depressor effect.

Among the first operations for relief of hypertension were sympathetic denervations of the upper and lower extremities. This did

not affect a sufficient portion of the arterioles to modify the systemic blood pressure, and so, desiring to denervate not only the vessels of the lower extremities but also those of the abdominal cavity, the spinal roots from which sympathetic fibers proceed to the latter region were divided. In order to accomplish this, it seemed necessary to perform laminectomy and rhizotomy of the anterior and posterior roots from the sixth thoracic to the second lumbar segments, inclusive.

Following this operative procedure there was noted a definite and significant drop in blood pressure. In addition to interruption of the vasomotor fibers, there was paralysis of the abdominal muscles, which reduced the intra-abdominal pressure. While the desired effects on the blood pressure were achieved, the procedure was considered too radical as a routine form of treatment and a less hazardous procedure was sought. In view of the fact that the splanchnic nerves carrying the sympathetic fibers from the anterior roots to the abdominal viscera could be approached by a less extensive operation, they were resected as they entered the abdominal cavity between the curia of the diaphragm. Following this type of operation, a definite drop in blood pressure occurred and definite relief of symptoms was noted in milder and earlier cases, although results did not seem so satisfactory in the more advanced cases. For that reason the previously described rhizotomy was modified to the extent that only the anterior roots were divided. This procedure proved effective in bringing about a significant lowering of blood pressure.

A further modification of this type of operative procedure consisted of the division of the ninth thoracic to the second lumbar roots, inclusive, in an effort thereby to produce a maximal drop in blood pressure with a minimal amount of risk.

Several important observations have been made following the two types of rhizotomy. There have been no noticeable deleterious effects, except possibly slowing of the excretion of water, which has not resulted in serious complication. Absence of sweating over the abdomen and lower extremities testifies to the division of the vasomotor fibers. There is a postural drop in blood pressure in that the pressure is higher when the patient is prone and lower when the patient is erect. Lessened response in blood pressure to psychic, thermal and pain stimuli has been noticed, and marked change in the mean levels of both diastolic and systolic pressures has been maintained over a sufficient time to indicate definite therapeutic value.

It may seem radical to advise resection of the splanchnic nerves or extensive laminectomy and rhizotomy for patients who have this type of hypertension but who have very few symptoms yet, in the light of experience, it would seem that if operation is to be done at all, it should be done before

changes in cerebral, retinal, and renal arteries are too advanced.

In spite of the fact that cases are on record in which patients have been followed for two years after splanchnic resection and four years after rhizotomy and beneficial effects have persisted for these periods of time, this type of treatment of hypertension should be considered as investigative and more or less experimental until a larger series of patients have been treated and more time has elapsed for postoperative observation. If surgery of the sympathetic nervous system should prove of as permanent value in the control of progressive, primary, constitutional hypertension as it has in the treatment of some of the vascular diseases affecting the extremities and of other conditions in which hyperactivity of the sympathetic nervous system has been of etiological importance, then it will have achieved another victory in the treatment of a disease which has been found to be resistant to all other forms of therapy.

WINCHELL MCK CRAIG







HARRY M. SHERMAN  
1854-1921

# MASTER SURGEONS OF AMERICA

HARRY MITCHELL SHERMAN

**H**ARRY MITCHELL SHERMAN, the first specialist in orthopedic surgery on the Pacific Coast, was born in Providence, Rhode Island, November 23, 1854. His paternal ancestor came from England in 1633. On his mother's side, the family were descendants of an old French Huguenot family, Maurean by name.

His preliminary education was in St. Paul's School, Concord, New Hampshire, and in 1877 he was graduated as Bachelor of Arts from Trinity College, Connecticut. His medical degree was from the College of Physicians and Surgeons, New York, in 1880, which college later became the Medical Department of Columbia University. In that same year, Trinity College granted him the degree of Master of Arts. His hospital internship was in Bellevue, New York, and he served for a time as assistant surgeon at West Point Foundry, New York. In 1881, he became assistant to Dr. Murdock at Cold Spring-on-the-Hudson, and later had some experience as ship surgeon on one of the steamships of the Alexandre Line.

In February, 1885, he came to San Francisco and entered practice, soon becoming associated with the late Dr. George Chismore, the eminent urologist. Since he had had special training in orthopedic surgery with Dr. Lewis A. Sayre in Bellevue, he recognized in San Francisco an opportunity to develop that specialty, which until then had been in the hands of general surgeons. In 1886, he became orthopedic surgeon to the Children's Hospital, San Francisco, organized in 1875 by a group of women headed by Dr. Charlotte Blake Brown, and he soon made that institution the center of orthopedic surgery on the Pacific Coast.

In 1890, he married Matilda Barreda, daughter of Frederick Barreda, Peruvian minister to the United States. Mrs. Sherman died in 1895, leaving one son, Frederick Barreda Sherman. In 1896, Dr. Sherman spent a year in Vienna, studying orthopedics.

In 1900, Dr. Sherman married Lucia Hamilton Kittle, daughter of J. G. Kittle, of Ross, California. Of this marriage, there were two daughters, Lucia Kittle and Isabel, who, with the son, Frederick Barreda, and Mrs. Sherman, survive.

Dr Sherman suffered from asthma for a number of years, but notwithstanding this handicap, he had an unusually full professional life, with great accomplishment. Finally his heart broke down after an attack of influenza, and he died May 15, 1921.

Dr Sherman was made clinical professor of orthopedic surgery in the University of California in 1896, and professor of the principles and practice of surgery in 1899 which position he held until 1912. In 1901 he was appointed surgeon to St. Luke's Hospital, San Francisco, where he did much operative work. He recognized that in cleft palate work he could see in the depth much better if he had dark instead of white draping. He therefore experimented with colors in the operating room and finally hit upon dark green tiling and dark blue draperies and gowns as most restful to the eye, favoring illumination of the depth of surgical wounds. Like other of Dr. Sherman's original notions, the green color has been chosen for the tiling of operating rooms in numerous other institutions.

He was an active member in many surgical organizations—The American Orthopedic Association, 1899 (president in 1900), The American Surgical Association, 1905. In 1912 he was one of the organizers of the San Francisco Polyclinic and later did yeoman work in organizing the American College of Surgeons in California, of which organization he was one of the governors. It is of some interest to note that after the San Francisco earthquake and fire of 1906, Dr. Sherman was the inspiration for the opening of a teaching hospital for the University of California Medical Department—he started with one bed and one patient, he himself furnishing the equipment—an institution which has become one of the most prominent teaching hospitals in the country.

While Dr. Sherman's chief work was in orthopedics, he did not limit his efforts to that specialty, but did much creditable work in other fields—cleft palate, surgery of the spleen, surgery of tumors, and even brain surgery. He did much experimental work on suture of heart wounds. He operated a number of times for the removal of the gasserian ganglion for facial neuralgia, and it is fair to assume that the broader view of pathological problems thus acquired reacted to the betterment of his orthopedic surgery.

Endowed with tireless energy, he gave much time and thought to matters of public welfare. In his relations with his fellow man, he was always the gentleman in the best sense of the word.

In the late war, having been for some years an officer in the Medical Reserve Corps of the United States Army, he was called to active duty, with rank of major, and served as surgeon in command of the Army Hospital at Fort Rosecrans, San Diego, until the end of the War. As a teacher, and in his clinical work, he was painstaking to an extreme and his private and hospital records are models of concise, systematic work, largely in his own hand.

Of Dr Sherman's contributions, perhaps the following are most noteworthy

Open operation for congenital dislocation of the hip, in which he overcame the usual rotation of the femur by an infratrochanteric osteotomy, holding the fragments in proper position by means of drills or spikes incorporated in the plaster-of-pairs dressing. A more fundamental idea was the use of sterile salt solution as a filling for cavities in bones and other places, Sherman making the point that the fluid was eventually replaced by blood into which bone gradually grew, and the irritation from foreign bodies such as the various pastes which had been previously used, was avoided.

He invented an extremely useful instrument, a spreader for opening plaster-of-pairs splints.

In 1902 he presented a notable paper before the American Surgical Association on the surgery of the heart.

Dr Sherman's position as surgeon is not to be measured by his contributions to literature, for they were not numerous, though of telling quality, but by his influence on those who came into contact with him, for they could not fail to catch some of his enthusiasm. He was a careful and thorough clinician, an excellent operator, a splendid teacher, who had the faculty of attracting young men to his work, and it is noteworthy that the present generation of orthopedic surgeons in San Francisco were nearly all Sherman's students.

LAMART RIXFORD

# EARLY AMERICAN MEDICAL SCHOOLS

## THE HISTORY OF RUSH MEDICAL COLLEGE

GOLDER LEWIS MCWHORTER, M D, Ph.D., CHICAGO

**R**USH MEDICAL COLLEGE was granted a charter on March 2, 1837 antedating that of the city of Chicago by several days. It was the only medical school in Chicago until 1859 and the only one of five pioneer medical schools in that vicinity to continue without interruption to the present time.

Largely to Daniel Brainard (Fig 1) must be given the credit for its establishment and early development. Arriving in Chicago in 1836, only two years after his graduation from Jefferson Medical College, he soon demonstrated unusual foresight, ambition and executive ability. Chicago, at this time, was a rapidly growing village of three thousand. In the adjacent community were many practitioners who had received either no medical education or had failed to graduate, while only about 20 per cent of them were medical graduates. Due to the poor transportation, the demand for physicians was great and the expense together with the inaccessibility of the few eastern medical schools placed the study of medicine largely beyond the reach of possible students from the local community.

Resulting from the local need at this time, there developed five pioneer medical schools in the vicinity of Chicago.

The medical department of LaPorte University was founded in 1842. It became the medical department of Indiana Medical College in 1848 and was discontinued in 1850.

Franklin Medical College was organized at St. Charles, Illinois in 1842 and discontinued in 1849.

The medical department of Illinois College at Jacksonville was established in 1843 and discontinued in 1848.

Rock Island Medical School was organized in 1848, moved to Davenport, then to Keokuk, and later became a part of the University of Iowa.

Rush Medical College was named after Dr. Benjamin Rush (1745-1813) of Philadelphia. He was one of the foremost medical men and citizens of his time, a graduate of Princeton in 1760, Edinburgh in 1768, professor of medicine in the University of Pennsylvania, a signer of the Declara-

tion of Independence, and treasurer of the United States mint from 1799 to 1813.

In his publications in 1854, Daniel Brainard did not appear to favor the name Rush. He termed himself professor of surgery of the Medical College of Illinois at Chicago and later called it the Medical College of Chicago without mentioning the name Rush. Perhaps the lack of more than grateful appreciation by the relatives of Rush, to the commemoration of his name at a time when the College was in serious financial straits was the reason.

Although a charter was obtained in 1837 with the expectation of an early opening of the school, economic conditions were very bad and it would probably not have opened in 1843 but for the organizing of the schools at LaPorte and St. Charles. This forced Daniel Brainard to open Rush sooner than he wished.

As a result an announcement was issued in October, 1843, stating that the first session would begin December 4, 1843 and continue for 16 weeks, before obtaining a college building. The lectures were given in the second story of a frame building occupied by Dr. Brainard as his office and next door to his home, at 49 South Clark Street, at the south east corner of the alley south of Lake Street. The requirements for the degree of doctor of medicine were, "Three years study with a respectable physician, two courses of lectures, one of which must be in this institution (or two years practice will be received in lieu of one course). The candidate must be 21 years old, of good moral character, must present a thesis on some medical subject of his own composition, and in his own handwriting, which shall be approved by the faculty, and pass a satisfactory examination on all the branches taught in this College."

The first course was given to a class of 22 students with one graduate. The instruction was given by four men with an average of four lectures a day. From the first, clinical teaching was established in the dispensary. This was opened by Dr. Blaney in 1839 as the first free dispensary in Chicago. Upon the opening of the College

in this block in 1843, it was transferred to the College quarters. In 1845 this dispensary was moved to Wolcott and Kinzie Streets and called the City Dispensary. Later it was adopted as a county institution.

During the summer of 1844 a building for the College was erected north of the river at Indiana and Dearborn Streets at a cost of about \$3500 00 (Fig. 2). This served without a change for eleven years. The land was donated by interested real estate men while the faculty and a few others furnished the money.

Austin Flint, as professor of medicine, gave the introductory address in the new building, the first annual anniversary of Rush. He remained only one year, due, partly to an inadequate income from the ticket fees by the students.

Medical instruction at first given by a few of the leading physicians in the larger communities was now rapidly taken over by these pioneer medical schools. With the phenomenal growth of Chicago and the strong faculty at Rush it soon became the dominant medical school. There was also considerable feeling against them in the smaller communities because of the necessity for grave robbing, and many gruesome tales are told of these early teachers of anatomy and their students who had to obtain their own specimens for dissection. The robbing of a grave at St. Charles caused local indignation to run high with the death of one student and the closing of that medical school in 1849. It was not until 1885 that the State of Illinois legalized the disposition of unclaimed bodies to medical institutions for use in teaching.

By 1850 three of the other five pioneer medical schools had discontinued and a fourth had moved west of the Mississippi River. Five hundred and thirty-two students had studied and 132 had graduated from Rush which had now become strongly established.

While these pioneer medical schools were often referred to as "proprietary," this was not literally the fact, although the property rights did rest with boards of trustees which included medical men.

Among the original seventeen trustees of Rush, only one was a physician and he was not on the faculty. However, shares of stock in Rush Medical College were issued and sold largely to the faculty members who, from time to time, were called upon to finance the institution. Dividends were also paid upon this stock.

In the summer of 1850 Chicago had a population of over 25,000. The United States Marine Hospital located only a short distance from the

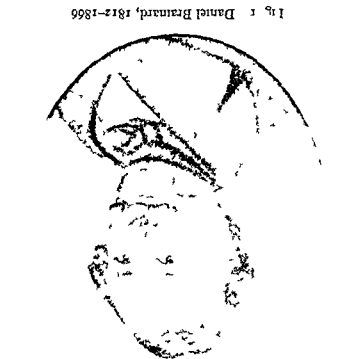


Fig. 1 Daniel Brainard, 1812-1866

College was nearing completion. Professor Herwick of the College assumed charge and clinics were held there in 1853-54. The Illinois General Hospital of the Lakes, or the "Lake House," was organized with a lying-in department. It came under the management of the Sisters of Mercy and after the first year was called Mercy Hospital. In 1851-52 Professors Brainard and Davis were in charge of the surgical and medical services and held clinics there. In the College announcement of that year there appeared, but not without some objection, the notice that the requirements of graduation would include hospital attendance.

In 1855 the College building was enlarged to accommodate about 250 students at a cost of \$15,000 00 sustained by the faculty. A museum was included with space for many specimens which had been collected by Professor Brainard in Europe.

In 1856 the College announcement contained a defence of hospital ward teaching as practiced the preceding four years in the Mercy and Marine Hospitals.

Early in 1859 N. S. Davis and a group of the faculty who favored a graded course of instruction resigned and founded what was for a time known as the Medical Department of Lind University, afterward as the Chicago Medical College, and later the Medical Department of Northwestern University, Mercy Hospital being used for their clinical teaching.

Hospital located only a short distance from the

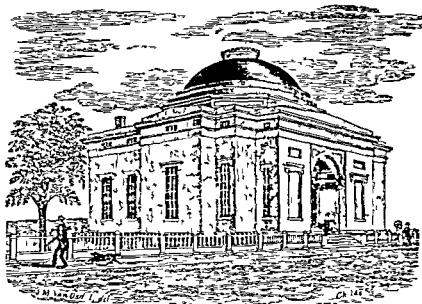


Fig. 2 Rush Medical College building erected in 1844.

Rush Medical College then announced that in addition to the Marine Hospital they would use the newly opened 200 bed City Hospital for teaching. Following the Civil War the City Hospital was taken over as the Cook County Hospital in 1866.

A course of lectures was inaugurated in the spring and early summer in 1859 by the Rush faculty. In 1860 the College announcement called it the Chicago Summer School of Medicine. This was later called the spring and summer lecture course of Rush Medical College and continued almost without interruption until the regular course was extended to 8 months in 1893. In 1860 the College announced a preliminary course of lectures of 2 weeks in addition to the regular course of 16 weeks.

Daniel Brainard died of Asiatic cholera October 10, 1866, aged 54 years, during an epidemic in Chicago then a city of 200,000. Despite this the College continued without interruption.

In May, 1867, the corner stone of an additional building containing an amphitheater with 625 numbered seats was laid and the old structure remodeled at a cost of about \$70,000.00 which was financed by the faculty.

In the spring of 1867, Moses Gunn was invited to the chair of surgery and for 20 years until his death rendered a great service to the institution. In 1867 the requirement of a formal thesis was abandoned and the regular course was increased from 16 to 18 weeks. In 1871 it was increased to 20 weeks.

On October 9, 1871 during the great fire the buildings of the College were burned. There was almost a complete loss from the fire and Rush was left \$65,000 in debt largely to the faculty.

Teaching was continued in a clinical amphitheater of the Cook County Hospital and in the dissecting rooms of the Chicago Medical College generously offered to them. The rebuilding was delayed until the permanent location of the new County Hospital could be determined so that the College building could be erected adjacent to it.

During this period a temporary crude brick structure for lecture and dissecting rooms, costing about \$4,000.00 was built on the grounds of the old County Hospital at 18th and Arnold Streets. The College occupied this for 4 years from 1872 to 1876. The corner stone of the building at the present location, the corner of Harrison and Wood Streets, chosen because it was diagonally opposite the new Cook County Hospital was laid November 20, 1875. The formal opening took place on October 4, 1876 (Fig. 3). The lot and building cost about \$54,000.00. Most of the money was obtained from the faculty and \$11,000.00 from the Central Free Dispensary which occupied the first floor.

From the first use of the Blaney Dispensary, Rush has always maintained the importance of clinical teaching. When the first building was erected clinics were held there for the medical and surgical treatment of patients before the students. This dispensary was abandoned with the burning of the building in 1871. The County Hospital



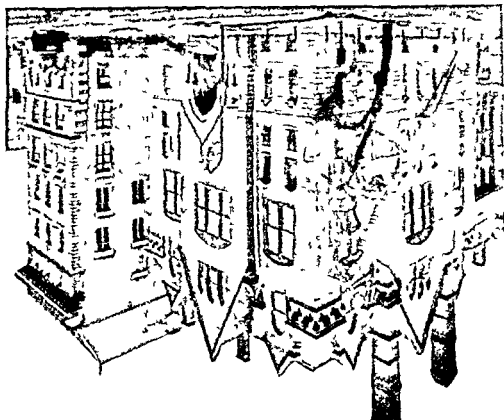


Fig. 3 The corner building of Rush Medical College which was used from 1876 to 1924 when it was replaced by the Kawson Building. Senn Hall in the background is still in use

clinics were used until the opening of the new

The Central Free Dispensary was organized

May 4, 1867, under the title of the Brimard Free

Dispensary and was supported at first by private

donations, occupying small rooms at 239 W. Ran-

dolph Street. In 1873 it was united with the Her-

rick Free Dispensary, founded in 1871. The endow-

ment at that time was brought up to \$1,000.00,

which in 1875 was lent to Rush for a first mort-

gage on the lot. The College agreed to provide

rooms for the dispensary and to furnish medical

service with the privilege of using the patients as

teaching material for the students

While these quarters were changed in June,

1902, to Senn Hall and later back to the Kawson

Building the clinical teaching in the dispensary

has never been interrupted. The dispensary and

County Hospitals may be called the three prin-  
cipal assets of Rush Medical College. The Presby-  
terian Hospital was organized and building started

In 1882 for the first time a preliminary exami-

nations required in English, physics, and mathe-

matics was held for those matriculating in Rush

schools or their equivalent. This was necessary to

quality for practice in Illinois (1884). At this

time instruction in the College began to assume a

graded character

In 1877 the regular course was increased from

20 to 22 weeks

In 1879 the College urged, but did not require

for graduation, attendance at the spring and sum-

mer terms, in addition to the regular term of at

least 2, if not 3 years, with a minimum of 3 years

of study as heretofore. The period of study was

divided into six terms over 3 years

In 1887 the College required, in addition to

studying medicine at least 3 years, that the mini-

mum of two required courses of lectures for the  
degree of medicine must not have been delivered  
in "one twelve-month"

After the death of Moses Gunn in 1887, Charles  
T. Parkes was given the chair of surgery and  
Arthur Dean Bevan, a graduate of Rush (1883),  
was elected to the chair of anatomy. In 1888  
Nicholas Senn was given the chair of principles of  
surgery and surgical pathology

In 1889 the College announced that beginning in 1891 three full courses of lectures, at least 6 months each, would be demanded for graduation.

In 1891, at the death of Charles T. Parkes, Nicholas Senn was given the chair of surgery.

In 1892 the announcement stated that each matriculate, in accordance with the state law, must study medicine 4 years and take three courses of lectures of at least 5 months each. The College requirements for graduation were increased to 4 years of study and an attendance at three courses of lectures of 6 months each.

In 1893 the regular course was made to cover 8 months and the spring course was discontinued.

A new laboratory building was dedicated on December 4, 1893 just 50 years after the beginning of the first course of lectures.

In 1894 it was announced that after 1895 four full courses of lectures would be required of 8 months each in graded courses. This requirement was changed to go into effect June 1, 1897. At this time (1897) the College still held preliminary examinations for students who were not graduates of high schools or their equivalent.

The early affiliations of Rush Medical College are only of historical interest, as they created no change in the methods of teaching or indeed affected the College in any noticeable manner.

In the annual announcement for 1862-63 Rush Medical College was recognized as the medical department of the University of Saint Mary's of the Lake, located at the corner of State and Huron Streets. No further notice was ever made.

On May 1, 1875, plans were made for Rush to become a department of the old University of Chicago. Although so described in the announcement of 1874-75 the union was never consummated and the subject was never mentioned again in the meetings of the trustees of the College.

In June, 1887, Rush Medical College became the Medical Department of Lake Forest University, but it did not involve any close relations and each retained its own autonomy. This relation was dissolved by mutual consent in April 1898, and almost immediately the affiliation of the College with the University of Chicago was established. The affiliation of Rush Medical College in June, 1898, marked an epoch in medical education not only in the College but in the history of medicine in America.

By the terms of this affiliation, the College surrendered control of its property to the University, which at this time made it clear that it was not its intention for Rush to necessarily become its medical school. The University stated that it proposed to establish its own medical school when funds

became available. Rush adopted as far as possible the general regulations of the University. One of the most satisfactory has been the continuous session, or four quarter arrangement, of the college year. This was established for the session of 1899-1900, when the first 2 years of the medical course was transferred to the University.

The increased requirements led to a falling off of the number of students, the lowest being in 1905-06 when the freshman class numbered about 65. This was a marked contrast to the classes of 200 to 250 which was the rule in the preceding years. Few changes were made in the clinical faculty except to increase it somewhat in numbers.

Since 1914 the requirements have included a fifth year consisting of a hospital internship or of a fellowship in one of the departments.

With the death of Nicholas Senn in 1908, Professor Arthur Dean Bevan succeeded him as head of the department of surgery. In 1934 Dr. Vernon C. David was given the chair of surgery at the retirement of Professor Bevan who had served his Alma Mater as a teacher for 46 years.

In May, 1924, a new contract was executed between the Corporation of Rush Medical College and the University of Chicago, in accordance with which the affiliation of 1898 was superseded and the University took over the work of the College as a department. This went into effect June 16, 1924. Thereafter only the last two years of clinical work has been offered by Rush Medical College.

With the organization of the School of Medicine of the Division of the Biological Sciences of the University of Chicago, the work of the first 2 years of medicine, formerly given in co-operation with Rush, was increased to include the third and fourth clinical years, in the university hospitals and clinics. It was so arranged that the work of the third and fourth years could be taken either on the quadrangles or in Rush Medical College. In 1924 the old college building, used since 1876, was replaced by the Rawson Clinical Laboratory and the Norman Bridge Laboratory of Pathology.

Before the affiliation of Rush with the University there were 5,225 graduates. To September, 1934, there has been a total of 9,917 graduated from Rush Medical College.

Rush Medical College, through the efforts of its faculty, by means of its opportune and successful affiliations with clinics, hospitals, and the University of Chicago, and through the discoveries and services of the physicians who have studied there, has achieved immortality. May Rush so continue, as in the past, to signify the best in medicine.



and has been instructed about home management and when to call again.

The writer has never seen anything approaching this mastery of the clinical material or of the technical means. This was equally displayed in the work at the Royal Southern Hospital, where Mr. Jones has a surgical service. On his regular operating day Wednesday he often exceeds twenty operations. On the Wednesday at which the writer was present he did twenty-six beginning at 2.30 p.m. he finished at 9.00 doing every operation himself but one, which was done by the house surgeon. The operations were done on a table which was also used as a stretcher and by having two of these stretcher tables and two anaesthetists, the operations followed each other with almost clocklike punctuality at an average interval of fifteen minutes and without any appearances of haste. When one considers that this included dressing in most cases and that there were three knee resections, and other operations of equal importance, the performance seems little short of marvellous. All the operations but one were undertaken for the relief of deformity or joint disease.

Here as in the office practice the striking thing was the clear and quick appreciation of the gist of the matter in hand and the instant application of the simple and effective remedy. Another striking feature of the work was the hearty and intelligent co-operation of his associates. Mr. Jones has attracted to himself a group of young men of skill and experience who vie with each other in their devotion to him and to the work, and whose team play if I may use the expression is remarkably effective. There is no question by precedence, the right man is always on hand to do the right thing in the right way. The spirit of the place is as fine as the work and personality of the master.

With the trying days of 1914 came Sir Robert Jones' great opportunity, but opportunity freighted with grief and great responsibility. How well he acquitted himself and how ably he discharged that responsibility cannot be told in a few words. Most American surgeons are familiar with the story, and both the older surgeons and those who 20 years ago were too young to appreciate its significance will delight in reading it in Watson's book. It has added still greater lustre to that of the profession in which we are proud to be enrolled. It has been beautifully summarized by an anonymous writer in the *Journal of Bone and Joint Surgery* (vol. 15, page 542).

Behind his genial smiling countenance, and apparent simplicity Robert Jones possessed the keenest brain, the most brilliant organizing ability and the tact, the patience, the perseverance and the astuteness of a diplomat. Never was man faced with greater difficulty or with more serious opposition than he was in the early days of the War when he was entrusted with the establishment of the first military orthopaedic service of this or any other country. He was appointed to the war office as Director of Orthopaedics with the rank of Hon. Major General. England's home service began with 60 beds at Alder Hey in Liverpool, but within a short time the help of many English and American Surgeons was enlisted and 35,000 beds were equipped and staffed with trained orthopaedic surgeons. The brain which had already solved the problems of the cripple in civil life readily adapted itself to the problems of war. Incredible as it may be, the gigantic task was accomplished and a complete service established from first aid treatment in the field to the last stages of re-education and after-care. In 1918 he continued and completed his military orthopaedic work through his appointment as Hon. Consultant to the Ministry of Pensions. In recognition of his war services His Majesty conferred upon him the C.B. and later a knighthood, and the United States Army awarded him the Distinguished Service Medal.

After the weary years of war were ended and its tragic aftermath had to some extent been cleared away, Sir Robert Jones might well have retired to a life of ease and contemplation of years well spent. He had made the main principles of Hugh Owen Thomas acceptable to the medical profession," and had

established the specialty of orthopaedic surgery on a firm foundation. Instead of giving up, however, he plunged into the work that always seemed to crowd upon him more vigorously than ever. The cause of the cripple, which had always been so close to his heart, claimed a large share of his attention. To the organization of a national scheme for caring for the physically handicapped and for the prevention of tuberculosis and of rickets—those diseases which contributed so many new recruits to the army of cripples—he devoted that same energy and organizing ability which had accomplished so much for the wounded soldier. The map of England and Wales, dotted with strategically located orthopaedic hospital schools and orthopaedic clinics, tells better than words how successful his efforts were.

While continuing on a larger scale than ever the surgical practice which he had been forced to give up during the war he still found time to edit the *Orthopaedic Surgery of Injuries* which appeared in 1921 and to write in collaboration with Robert Lovett the *Textbook of Orthopaedic Surgery* (1923) which 'records for mankind' the principles and teachings which he constantly exemplified in his surgical work.

It seems incredible that in spite of advancing years he could still continue work and play at the strenuous pace that he set for himself, but

readily, a leisurely old age, an opportunity to take things easily—all these would have been terrible to him. With ebbing strength, he surveyed the past and set no value on the future. If he could not be in the heart of the battle of life, he shrank from a place in the shadows.

In December 1932 after a year of gradually declining strength he began to fail rather rapidly and on January 14 1933 he fell quietly asleep.

To have lived a life so fruitful, so filled with service to his fellow men and to have gone to his last resting place loved and mourned by family, by associates, by students by patients—in short by all who knew him—falls only to the lot of a fortunate few. Watson might well have added to his book the beautiful tribute which appeared in the *Journal of Bone and Joint Surgery* (vol. 15, pages 541-543) which begins and closes with the paragraphs

The kindly word, the cheery smile, the twinkling eye, the whole magnetic personality of Sir Robert Jones remain only as a memory. The world's greatest orthopaedic surgeon has completed his life's work quietly as he was born seventy-four years ago at Rhyl on the North Wales coast, just as quietly he died in the early days of this year at a little village in Montgomeryshire.

and

Throughout his career he practised in Liverpool, and Liverpool has paid its last and greatest tribute to the honor of one of its citizens. The ashes of Sir Robert Jones are the first to find a resting place within the walls of the Cathedral. The urn stands on a column of stone, close to the foundation pillar beneath the stained glass window dedicated to Service. As long as the walls of that vast cathedral stand, they will shelter all that has died of Robert Jones, as a token and a memorial of his service to mankind. In the hearts and minds of those who came within the glow of his presence and who learned humbly to love him, his spirit still lives.

STUMER L. KOCH.

# VOLUMES VII and IX of the twelve

*Cyclopaedia of Medicine* edited by George M.

Peters and Edward L. Hotz are now available

(Review of first seven volumes appeared in the

December, 1933, issue, page 832.) Volume vii con-

tains the alphabetical arrangement of the subjects

beginning with the letter "L," and the first topic is

"Larynx, Disorders of." This section covers 69

pages and includes infections and nervous disorders

together with the tumors of the organs. The section

on metabolism is given 151 pages and covers pro-

teins, fats, carbohydrate, and minerals. Mylth is

the last subject appearing in this volume and its

pharmacology, preparations, dosage, and thera-

peutics are discussed briefly. Volume ix begins with

a discussion of their structure, de-

formities, care, and disorders. A section of 70 pages

is given to plastic surgery where technique is

described and illustrated quite freely. The subject

of pneumonia is well done. A discussion of potassium

and its preparation and doses ends this volume

Attention is called to these topics only in that they

indicate the general nature of the subject matter

treated.

The volumes are 7 by 10 inches and the binding

has been changed from the flexible to the conven-

tional stiff type. The material is well arranged and

the treatment of the subjects are concise and re-

markably complete.

At HERBERT BARBER

THE purpose of Dr. Vaughan's monograph of 248

pages is to review the present position of the

knowledge of the anemias. She has been assisted

by Professor H. M. Turnbull in the description of

the pathological anatomy of various anemias. In

the first chapter, a review of normal erythrocyte

measurements and a brief account of the anatomy

and physiology of erythropoiesis are presented. The

anemias are classified under the general headings of

erythromatosis, post-hemorrhagic, hemolytic, and

unclassified anemias. The anemias of infants and

children are included in the classification and in the

clinical descriptions. Each individual type of

anemia is considered from the standpoint of etiology,

symptomatology, diagnosis, and treatment. Abun-

dant reference to the literature is made throughout

the text.

Under the grouping of the deficiency dyshemo-

poietic anemias, the recent conceptions and intera-

ture concerning iron deficiency anemia and anemia

due to deficiency of the peroxidase anemias factor are

presented. The relationships of this group to ab-

normalities of the gastro intestinal tract is brought

out. Under unexplained dyshemoopoietic anemias,

the author includes the less common leuco erythro-

blastic anemias. This type of anemia was observed

in diseases involving the bones which included

osteomyelitis.

The Anemias by Janet M. Vaughan D. M. (Oxon.) M.R.C.P.

Tells viii and ix Philadelphia F. A. Davis Co. 1934

The Cyclopaedia of Medicine George Morris Peters

Editor in Chief and Edward L. Hotz M.D. Assistant Editor

Vol viii and ix Philadelphia F. A. Davis Co. 1934

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Tells viii and ix Philadelphia F. A. Davis Co. 1934

The Cyclopaedia of Medicine George Morris Peters

Cooley's anemia. It is suggested that these condi-

cells of food factors necessary for normal ripening

thrombotic tissue but rather by depriving the blood

Further under dysphemoopoietic anemia, a descrip-

tion is given of erythroid blastosis fetalis which includes

hydrops fetalis, icterus gravis neonatorum and

congenital anemia of the newborn.

Dr. Vaughan has drawn frequently from her own

experience in giving specific details of the findings

in various anemias. Characteristic diameters of the

erythrocytes are illustrated in the accompanying

Price-Jones curves. The material in general is pre-

sented on the basis of the evidence at hand and there

is little if any tendency toward dogmatism. It is of

interest that more than half of the articles form the

large bibliography appeared after 1929. If hemat-

ologic research continues to progress as it has in the

past ten years. It should also serve as a valuable

reference book to workers in the field of hematology.

Howard L. Alt

It is a pleasure to see Wright's *Applied Physiology*,

appearing in its fifth edition. Its remarkable popu-

larity among medical students is due to a number of

virtues too often lacking in the medical literature of

the past. One of these is utmost conciseness of ex-

pression, it would be hard to find, in these 604 pages,

a single superfluous word. Another is utmost con-

creteness of expression, for every generalization

there is a specific instance, stated qualitatively

when possible. These features adapt the book exact-

ly to its purpose, which is to give an up to date

summary of those facts of human physiology which

have clinical application. It is not a book for a be-

ginner, since introductory, historical, and laboratory-

technical material is excluded. It is a book for the

point simulating in his study of physiology. It

contains material useful and interesting to physicians

and surgeons who find that even conscientious read-

ing of their journals sometimes fails to give a co-

herent idea of the present state of the science.

Among the subjects which many readers will be

particularly glad to have presented in this way, and

to which special attention has been given in the new

edition, are blood groups, nephroses, cademia, the

anemias, tissue oxidation, the carotid sinus, ischæm-

ic pain, sympatheticoemia, cholecystolimus, the pro-

lans, parathormone, and the hypophthalmus

FREDERICK T. JUNG

*Applied Physiology* By Samuel Wright M.D. F.R.C.P. 5th ed

New York and London Oxford University Press 1934

# CORRESPONDENCE

## CONCERNING A REGISTRY OF BRAIN TUMORS

*To the Editor* A series of some two thousand tumors of the central nervous system collected by Dr Harvey Cushing during his period of service at the Johns Hopkins Hospital and the Peter Bent Brigham Hospital has been brought to the Yale School of Medicine and put under the curatorship of the undersigned. It is intended that these elaborately catalogued specimens should so far as possible be made useful to those interested in the subject, and it is hoped that the collection will be added to from many sources.

There are many problems relating to tumor classification and expectancy of life after tumor removal that are as yet unsolved. Hence this series of cases may be of help to those who will encounter rare

tumors that they wish to have identified if possible, and concerning which they may desire information, particularly on the basis of type prognosis.

Anyone who may feel inclined to send specimens for diagnosis or may seek information of other sorts is welcome to do so. The following persons, several of them already familiar with much of the material, have kindly consented to act as an advisory board:

PERCIVAL BAILEY University of Chicago  
F C GRANT, University of Pennsylvania  
S C HARVEY, Yale University  
G J HEUER Cornell University  
WILDER PENFIELD McGill University  
FERNST SACHS Washington University  
W P VAN WAGEN, University of Rochester  
S B WOLBACH, Harvard University

LOUISE EISENHARDT, M D, New Haven Hospital

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

*THE TREATMENT OF INJURIES OF THE HEAD AND SPINE* By Jewett V Reed M D Indianapolis C E Pauley & Co Inc 1934

*THE WELLCOME RESEARCH INSTITUTION AND THE AFFILIATED RESEARCH LABORATORIES AND MUSEUMS* Founded by Sir Henry Wellcome LL D D Sc FRS London England The Wellcome Foundation Ltd 1934

*INTRODUCTION TO DISCUSSION ON GEOGRAPHICAL DISTRIBUTION OF CANCER IN SPAIN* THE CANCER OF 1932 By Frederick L Hoffman LL D Madrid Blass, S A 1933

*TUBERCULOSIS OF THE LYMPHATIC SYSTEM* By Richard H Miller M D FACS New York The Macmillan Co 1934

*COLLANA DI MONOGRAFIE CHIRURGICHE* Directed by Prof Raffaele Paolucci Viceriti e Periviceriti, DIGESTIVE ADDOMINALI CRONICHE By Francesco Zagarese With a preface by Prof Raffaele Paolucci Bologna Nicola Zanichelli Editore 1934

*AN INTRODUCTION TO GYNECOLOGY* By C Jeff Miller M D 2d ed St Louis The C V Mosby Co 1934

*SYMPTOMS OF CENTROURINARY DISEASES* By Austin I Dodson M D FACS St Louis The C V Mosby Co 1934

*APPLIED ANATOMY, THE CONSTRUCTION OF THE HUMAN BODY CONSIDERED IN RELATION TO ITS FUNCTIONS DISEASES AND INJURIES* By Gwilym G Davis M D 9th ed completely revised by George P Muller M D Philadelphia, London Montreal J B Lippincott Co 1934

*ANNUAL CLINICAL REPORT OF THE GOVERNMENT HOSPITAL FOR WOMEN AND CHILDREN EGMORE MADRAS FOR THE YEAR 1933* Madras Government Press, 1934

*WEGE ZUR VERHÜTUNG DER ENTSTEHUNG UND AUFBREITUNG DER KREBLERANKHEIT* By Prof Dr Bernh Fischer Wasels. Berlin Julius Springer, 1934

*PRACTICAL OBSTETRICS FOR STUDENTS AND PRACTITIONERS* By P Brooke Bland M D and Thaddeus L Montgomery M D 2d ed Philadelphia F A Davis Co 1934

*HEALTHY BABIES ARE HAPPY BABIES A COMPLETE HANDBOOK FOR MODERN MOTHERS* By Josephine Hemmaway Kenyon M D Boston Little Brown Co 1934

*CATARACT ITS ETIOLOGY AND TREATMENT* By Clyde A Clapp M D, FACS Philadelphia Lea & Febiger 1934

*TUMORS OF THE FEMALE PELVIC ORGANS* By Joe Vincent Meigs, AB M D FACS With a Foreword by Robert B Greenough, M D New York The Macmillan Co 1934

*THE CYCLOPEDIA OF MEDICINE* Edited by George Morris Piersol BS, M D assisted by Edward I Bortz AB M D Vol XI Philadelphia F A Davis Co 1934

*THE SCIENCE AND PRACTICE OF SURGERY* By W H C. Romanis M A, M B, M Ch (Cantab) F R C S (Eng) F R S (Edin) and Philip H Mitchiner M D M S (Lond) F R C S (Eng) 5th ed Vol I—GENERAL SURGERY Vol II—REGIONAL SURGERY Philadelphia Lea & Febiger 1934

*AMEBIASIS AND AMEBIC DYSENTERY* By Charles F Craig M D M A (Hon Yale) FACP FACS Colonel U S Army Retired DSM Springfield Illinois and Baltimore Maryland Charles C Thomas, 1934

ATYPICAL GROWTH INDUCED IN CERVICAL EPITHELIUM OF THE MONKEY BY PROLONGED INJECTIONS OF OVARIAN HORMONE COMBINED WITH CHRONIC TRAUMA<sup>1</sup>

MILTON D. OVERHOLSER, JR., D. V. D., and EDGAR ALLEN, JR., D. V. D., COLUMBIA, MISSOURI

Department of Anatomy, University of Missouri

**T**HE ovarian follicular hormone has been shown by Allen (1927, 1932) and by many others to be a powerful stimulator of epithelial growth in the female genital tract and breast.

and breast

Lingemanse, Fred, de Jongh, and La-

quantum (1930) reported an average amount of the female sex hormone in the

analyses of the female sex hormone in the blood of cancer patients, both male and fe-

male Loeve, Raudenbush and Voss (1932)

found increased amounts of the sex hormone

in cancer tissue from men

Lathrop and Leo Loeb (1916) found that

ovariectomy of female mice markedly de-

THE UNIVERSITY OF CHICAGO

STUDY: 1991-1992, 1993-1994, 1995-1996, 1997-1998, 1999-2000, 2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010, 2011-2012, 2013-2014, 2015-2016, 2017-2018, 2019-2020, 2021-2022, 2023-2024, 2025-2026, 2027-2028, 2029-2030, 2031-2032, 2033-2034, 2035-2036, 2037-2038, 2039-2040, 2041-2042, 2043-2044, 2045-2046, 2047-2048, 2049-2050, 2051-2052, 2053-2054, 2055-2056, 2057-2058, 2059-2060, 2061-2062, 2063-2064, 2065-2066, 2067-2068, 2069-2070, 2071-2072, 2073-2074, 2075-2076, 2077-2078, 2079-2080, 2081-2082, 2083-2084, 2085-2086, 2087-2088, 2089-2090, 2091-2092, 2093-2094, 2095-2096, 2097-2098, 2099-2100, 2101-2102, 2103-2104, 2105-2106, 2107-2108, 2109-2110, 2111-2112, 2113-2114, 2115-2116, 2117-2118, 2119-2120, 2121-2122, 2123-2124, 2125-2126, 2127-2128, 2129-2130, 2131-2132, 2133-2134, 2135-2136, 2137-2138, 2139-2140, 2141-2142, 2143-2144, 2145-2146, 2147-2148, 2149-2150, 2151-2152, 2153-2154, 2155-2156, 2157-2158, 2159-2160, 2161-2162, 2163-2164, 2165-2166, 2167-2168, 2169-2170, 2171-2172, 2173-2174, 2175-2176, 2177-2178, 2179-2180, 2181-2182, 2183-2184, 2185-2186, 2187-2188, 2189-2190, 2191-2192, 2193-2194, 2195-2196, 2197-2198, 2199-2200, 2201-2202, 2203-2204, 2205-2206, 2207-2208, 2209-2210, 2211-2212, 2213-2214, 2215-2216, 2217-2218, 2219-2220, 2221-2222, 2223-2224, 2225-2226, 2227-2228, 2229-2230, 2231-2232, 2233-2234, 2235-2236, 2237-2238, 2239-2240, 2241-2242, 2243-2244, 2245-2246, 2247-2248, 2249-2250, 2251-2252, 2253-2254, 2255-2256, 2257-2258, 2259-2260, 2261-2262, 2263-2264, 2265-2266, 2267-2268, 2269-2270, 2271-2272, 2273-2274, 2275-2276, 2277-2278, 2279-2280, 2281-2282, 2283-2284, 2285-2286, 2287-2288, 2289-2290, 2291-2292, 2293-2294, 2295-2296, 2297-2298, 2299-2300, 2301-2302, 2303-2304, 2305-2306, 2307-2308, 2309-2310, 2311-2312, 2313-2314, 2315-2316, 2317-2318, 2319-2320, 2321-2322, 2323-2324, 2325-2326, 2327-2328, 2329-2330, 2331-2332, 2333-2334, 2335-2336, 2337-2338, 2339-2340, 2341-2342, 2343-2344, 2345-2346, 2347-2348, 2349-2350, 2351-2352, 2353-2354, 2355-2356, 2357-2358, 2359-2360, 2361-2362, 2363-2364, 2365-2366, 2367-2368, 2369-2370, 2371-2372, 2373-2374, 2375-2376, 2377-2378, 2379-2380, 2381-2382, 2383-2384, 2385-2386, 2387-2388, 2389-2390, 2391-2392, 2393-2394, 2395-2396, 2397-2398, 2399-2400, 2401-2402, 2403-2404, 2405-2406, 2407-2408, 2409-2410, 2411-2412, 2413-2414, 2415-2416, 2417-2418, 2419-2420, 2421-2422, 2423-2424, 2425-2426, 2427-2428, 2429-2430, 2431-2432, 2433-2434, 2435-2436, 2437-2438, 2439-2440, 2441-2442, 2443-2444, 2445-2446, 2447-2448, 2449-2450, 2451-2452, 2453-2454, 2455-2456, 2457-2458, 2459-2460, 2461-2462, 2463-2464, 2465-2466, 2467-2468, 2469-2470, 2471-2472, 2473-2474, 2475-2476, 2477-2478, 2479-2480, 2481-2482, 2483-2484, 2485-2486, 2487-2488, 2489-2490, 2491-2492, 2493-2494, 2495-2496, 2497-2498, 2499-2500, 2501-2502, 2503-2504, 2505-2506, 2507-2508, 2509-2510, 2511-2512, 2513-2514, 2515-2516, 2517-2518, 2519-2520, 2521-2522, 2523-2524, 2525-2526, 2527-2528, 2529-2530, 2531-2532, 2533-2534, 2535-2536, 2537-2538, 2539-2540, 2541-2542, 2543-2544, 2545-2546, 2547-2548, 2549-2550, 2551-2552, 2553-2554, 2555-2556, 2557-2558, 2559-2560, 2561-2562, 2563-2564, 2565-2566, 2567-2568, 2569-2570, 2571-2572, 2573-2574, 2575-2576, 2577-2578, 2579-2580, 2581-2582, 2583-2584, 2585-2586, 2587-2588, 2589-2590, 2591-2592, 2593-2594, 2595-2596, 2597-2598, 2599-2600, 2601-2602, 2603-2604, 2605-2606, 2607-2608, 2609-2610, 2611-2612, 2613-2614, 2615-2616, 2617-2618, 2619-2620, 2621-2622, 2623-2624, 2625-2626, 2627-2628, 2629-2630, 2631-2632, 2633-2634, 2635-2636, 2637-2638, 2639-2640, 2641-2642, 2643-2644, 2645-2646, 2647-2648, 2649-2650, 2651-2652, 2653-2654, 2655-2656, 2657-2658, 2659-2660, 2661-2662, 2663-2664, 2665-2666, 2667-2668, 2669-2670, 2671-2672, 2673-2674, 2675-2676, 2677-2678, 2679-2680, 2681-2682, 2683-2684, 2685-2686, 2687-2688, 2689-2690, 2691-2692, 2693-2694, 2695-2696, 2697-2698, 2699-2700, 2701-2702, 2703-2704, 2705-2706, 2707-2708, 2709-2710, 2711-2712, 2713-2714, 2715-2716, 2717-2718, 2719-2720, 2721-2722, 2723-2724, 2725-2726, 2727-2728, 2729-2730, 2731-2732, 2733-273

demonstrated a preliminary for the importance of an internal secretion for the

spontaneous development of cancer, and that

probably any factor which periodically in-

duced increments in growth energy, might

be a factor in the development of carcinoma.

COH (1937) reported that ovulation of female mice between the ages of 15 and 22

22 and 23 days after the occurrence of

spontaneous cancer of the breast, while the

controls of the same strain showed a mammary

cancer incidence of 78.5 per cent

Murray (1928), by removal of the ovaries at

4 to 6 weeks of age in a cancer strain of rats,

This work has been assisted by a grant from the Committee for Research

reduced the incidence of mammary cancer from 80 per cent to 17.1 per cent. If the males of this same strain, who never developed mammary cancer, were castrated and a whole ovary of a sister transplanted subcutaneously, then these males developed spontaneous mammary cancer in 71 per cent of the cases. Lacassagne (1932), using 3 young male mice from a strain in which only the females developed spontaneous mammary cancer, found that weekly injections of estrin in oil solution produced cancer of the mammary gland in all three males after 5 to 6 months of treatment. Cook and Dadds (1933) reported estrus exciting activity to be possessed by the two most potent carcinogenic hydrocarbons yet known. Zondek (1930) found the ovarian follicle-stimulating hormone of the anterior pituitary in the urine of 81.8 per cent of women with genital carcinoma. Hobbauer (1930) reported that anterior hypophysis transplants and extracts in guinea pigs produced a proliferation of the epithelium of the cervix into the subepithelial tissues which he considered to be a precancerous condition. His anterior pituitary treatment should have increased the production of the follicular hormone, although he interprets his

results as direct stimulation of the cervical epithelium by the pituitary hormone. He says "Die Deutung dieser Versuchsergebnisse kann nur so lauten, dass der Hypophysenvorderlappen einen spezifischen stimulierenden Einfluss auf das Deckepithel der Portio vaginalis und zu einem gewissen Grade auf das Zylinderepithel der Cervix ausübt."

These facts led us (Overholser and Allen, 1933) to study the changes produced in the cervical epithelium of the monkey by injections of genital growth hormones combined with chronic trauma.

#### MATERIALS AND METHODS

Nine *Macacus rhesus* monkeys were used. Seven were sexually mature and two immature. None of the animals had ever been pregnant so far as we know, although some of them were shipped to us without past histories.

The cervixes were traumatized by scissors cuts through a vaginal speculum. This procedure was repeated at 7 to 10 day intervals throughout the experiment. In addition to the cuts a small metal clip was clamped on the cervix in some of the animals. Subcutaneous

injections of hormone were made twice daily, morning and evening, as a rule. The daily dose of estrin (ovarian follicular hormone) given as theelin<sup>1</sup> or amniotin<sup>2</sup>, ranged from 50 to 360 rat units. The theelin preparation used contained 50 rat units per cubic centimeter. Two preparations of amniotin containing 200 and 50 units per cubic centimeter, respectively, were used. Four animals also received injections of corporin<sup>3</sup> (a hormone of the corpus luteum) during the latter part of the estrin injections.

#### EXPERIMENTS

**Monkey 1** This animal had been ovariectomized for some months previous to the experiment and the sexual skin was pale. The vaginal portion of the cervix was cut several times with a pair of scissors and the tissue squeezed tightly with a hemostat. On the following day injections of estrin were begun. In the first 17 days 1 660 rat units were injected.

Vaginal examination on the fourth and seventh days of the injections produced profuse hemorrhage from the cuts in the cervix and no additional trauma was made at these times. On the seventeenth day the sexual skin was red, the cervix appeared nodular and, as there was no bleeding, it was retraumatized. At this time all injections were suspended for 10 days. On the twenty-fourth day the sexual skin was still red, but examination revealed a stenosis of the vagina which prevented visualization of the cervix.

On the twenty-eighth day injections of estrin were begun again and in the following 62 days 3 830 rat units were injected.

Examination on the thirty-first day showed a red sexual skin and a persistence of the vaginal stenosis.

<sup>1</sup>Furnished by Parke Davis and Company for experimental purposes.

<sup>2</sup>Furnished by E. R. Squibb and Sons for experimental purposes.

<sup>3</sup>Prepared according to a method described by Turner, C. W. and Frank, A. H. *Mo. Agr. Expt. Sta. Res. Bull.* 174, 1932.

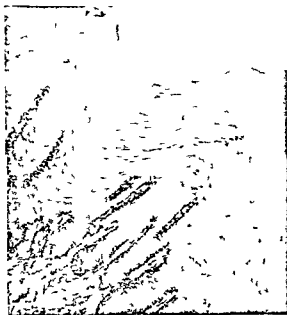


Fig 1 Monkey 1 Section of cervix showing extreme hyperplastic condition of epithelium following estrin injections.  $\times 77$



Fig 2 Monkey 1 Section of vagina showing definite cornified layer of the epithelium and pigment granules in the basal layer of cells.  $\times 300$



The stenosis was opened up with a knife and the vagina tightly packed with cotton. Seven days later (38th day) it was possible to view the cervix which was retraumatized, at this time the sexual skin was

red. On the forty fifth day a metal clip was clamped on the cervix. Examination 7 days later (52nd day) showed the clip still in place and the sexual skin very red. A week later (59th day) the clip was found loose in the vagina and was replaced on the cervix. The sexual skin was a bright red. Fourteen days later (73rd day) the metal clip was removed and several cuts made in the cervix, thus causing profuse hemorrhage. The clip was reapplied on the eighth day.

Ninety days after the injections were started the animal was killed. It had been losing weight and strength during the last weeks of the experiment, probably as a result of hemorrhage from the cervix. On the day of killing it was extremely emaciated and weak, being unable to rise. During the experiment a total of 5,490 rat units of estrogenic hormone were injected.

Autopsy showed the metal clip still attached to the cervix, which was hypertrophied and nodular. Sections are shown in Figures 1 to 5. Figure 1 shows the extreme hyperplastic condition of the epithelium covering the vaginal portion of the cervix. This is the usual follicular hormone effect (Allen, 1927). Figure 2 is a section of the vagina and shows a definite cornified layer of the epithelium. Pigment granules are also present in the basal layer of cells. Sections of the cervix taken near the junction of the (Figures 3 and 4) reveal epithelial downgrowth in the stratified squamous with the columnar epithelium.



Fig 4 Monkey 1 Section of cervix showing epithelial downgrowth and overgrowth with epidermization of cervical glands X50



Fig 3 Monkey 1 Section of cervix showing epithelial downgrowth and overgrowth. Epidermization of cervical glands. Enlarged bulbous rete malpighii X65

and overgrowth, columnar gland cells being partially or completely surrounded with stratified squamous epithelium. Enlarged bulbous rete malpighii are also seen in Figure 3. Figure 5 is a high power photograph of glandular epithelium surrounded by many layers of stratified squamous epithelium. As the latter increases in thickness the columnar cells of the gland are separated from their blood supply and degenerate. Nuclear variation is seen in the squamous cells, consisting of differences in size, shape, and staining reaction. This animal had been ovariectomized for some months previous to the experiment and the sexual skin was pale. The cervix was traumatized and on the following day injections of estrin were

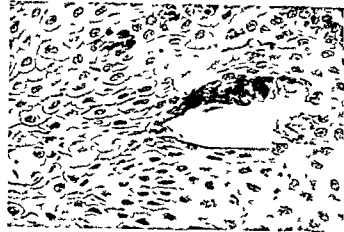


Fig 5 Monkey 1 Glandular, surrounded by stratified squamous, epithelium. Variation in size and staining reaction of the nuclei is seen X340

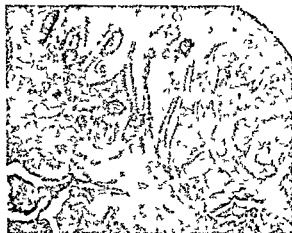


Fig 6 Monkey 2 Section of cervix at junction of stratified squamous with glandular epithelium. Epithelial hyperplasia resembling a leucoplakia.  $\times 77$

begun. In 17 days 1 660 rat units were given. The injections were then stopped and 3 days later (20th day) the animal was killed.

On the fourth and seventh days the cervix was retraumatized. The sexual skin was very red on the seventeenth day when the cervix was again traumatized.

At autopsy the cervix was hypertrophied and irregular. Sections of the cervix are shown in Figures 6 and 7. Figure 6 taken at the junction of the stratified squamous with the glandular epithelium shows a marked epithelial hyperplasia resembling a leucoplakia. Squamous epithelium surrounds columnar cells and there is marked downgrowth and irregularity of the rete malpighii. A round cell infiltration is seen in the connective tissue.

Figure 7 is a high power view from Figure 6. Three glandular tubules of columnar cells are completely surrounded with stratified squamous epithelium.

**Monkey 3.** This animal was ovariectomized the sexual skin being moderately red at the time. On the sixth day after ovariectomy the cervix was traumatized and a metal clip clamped on it. Cervical trauma was repeated on the twelfth day, the sexual skin being pale at this time. Injections of estrin were started on the twenty first day beginning with 40 rat units daily and increasing to 90 rat units daily in 17 days. Eight days after injections were started the sexual skin was red and remained so throughout the experiment. On the sixty ninth day (48 days of injections) the estrin was stopped after 3 947.5 rat units had been given. Fourteen cubic centimeters of corporin were then given in the next 8 days. 800 rat units of estrin being given with it. A total of 4 747.5 rat units of estrogenic hormone were therefore injected during the experiment.

Cervical trauma was repeated on the twenty second, twenty ninth, fortieth, fifty first, sixtieth, sixty eighth, and seventy seventh days. The metal



Fig 7 Monkey 2 A high magnification from Figure 6. Three glandular tubules of columnar cells completely surrounded with stratified squamous epithelium. Infection present.  $\times 300$

clip remained on the cervix throughout the experiment. Four days after all injections had been stopped (81st day) the animal was killed.

At autopsy the cervix was very nodular and irregular with several necrotic areas. Figures 8 to 10 show sections of the cervix. An ulcerating area was found in which there was marked downgrowth of the epithelium with formation of many isolated epithelial nests (Fig 8). A high power photograph of this region is shown in Figure 9. The borders of the epithelial masses are irregular with no basement membrane. The nuclei vary in size and shape and are hyperchromatic. A gland like lumen is seen containing a few leucocytes and epithelial cells. Leucocytes are also seen in the connective tissue.

Figure 10 shows an area of epithelial downgrowth and gland overgrowth with atypical epidermization. The columnar cells are undergoing degeneration. This is a duplication of the condition usually diagnosed as a precancerous lesion in human material.

**Monkey 4.** This animal was ovariectomized the sexual skin being very red at the time. Injections of estrin were begun 22 days later starting with 40 rat units daily and increasing to 90 rat units daily in 13 days. After 1 002.5 rat units of estrin had been injected in 15 days it was stopped and 10.7 cubic centimeters of corporin were then injected in the next 8 days. Injections were then discontinued for 23 days, following which 1 800 rat units of estrin were given in 5 days. All injections were then stopped and the animal was killed 33 days later. During the 51 day injection period a total of 2 802.5 rat units of estrogenic hormone and 10.7 cubic centimeters of corporin were injected.

No cervical trauma of any kind was given to this animal.

At autopsy the cervix appeared slightly irregular. Sections showed an extensive area of papillary gland overgrowth, much epidermization and many areas of distinctly atypical epidermoid cells (Figs 11 and 12). As there was also much infection it is probable that some old cervical injury was present.



Fig 8 Monkey 3 Section of cervix showing epithelial downgrowth and presence of isolated epithelial nests in an ulcerating area  $\times 50$



Fig 9 Monkey 3 Higher magnification of Figure 8. Epithelial masses are irregular with no basement membrane, hyperchromatic nuclei  $\times 250$

Monkey 3. This animal had been ovariectomized several months previous to the beginning of the experiment. The cervix was traumatized and 2 days later injections of estrin were begun and continued for 16 days, when the animal died. A total of 1,535 rat units of estrogenic hormone were injected. The cervix was retraumatized three times during this period.

At autopsy the cervix appeared somewhat nodular and by peritrophic, with several necrotic areas. Sections of the cervix showed a very hyperplastic epithelium indicating that the hormone treatment had been effective. A few areas of columnar epithelium surrounded by stratified squamous epithelium were present but this condition was not developed to such a degree as found in the other experiments that extended over longer periods of time.

Monkey 6. This was a young immature animal, the sexual skin being slightly pink. A double ovariectomy was performed and 3 days later the cervix was traumatized, a metal clip being also clamped on it. Cervical trauma was repeated on the eleventh day following the operation, the sexual skin being pale at this time.

On the twentieth day, injections of estrin were started, beginning with a daily dose of 40 rat units, which was increased to 90 rat units by the seventeenth day. After 1,112 rat units had been given in 29 days injections of corporin were begun, 16 cubic centimeters being given in the next 20 days. Thirty-two hundred rat units of estrin were injected along with the corpus luteum hormone. Injections were then stopped and the animal killed 12 days later (80th day). A total of 1,312 rat units of estrogenic hormone were injected.

Fig 10 Monkey 3 Section of cervix showing a condition usually diagnosed in women as precancerous  $\times 50$



Fig 10 Monkey 3 Section of cervix showing a condition usually diagnosed in women as precancerous  $\times 50$



Fig 11 Monkey 4 Section of cervix from animal that received hormone injections only Papillary gland overgrowth much epidermization and areas of atypical epithelial cells  $\times 85$

although in many regions of the cervical canal glandular cells were surrounded by stratified squamous epithelium. A large proportion of the vaginal epithelium had also been sloughed but intact areas were in a hyperplastic condition indicating that the hormone treatment had been effective. The sloughing of the epithelium in this animal was no doubt caused by severe infection.

**Monkey 7** This was also a young immature animal the sexual skin being slightly pink. A double ovariectomy was done and 5 days later the cervix was traumatized a metal clip being also clamped on it. Cervical trauma was repeated on the eleventh day following the operation.

On the twentieth day injections of estrin were started beginning with a daily dose of 40 rat units and increasing to 90 rat units in 18 days. Injections were continued for 32 days a total of 4,267.5 rat units being given. Eight days after the beginning of the estrin injections the sexual skin was slightly swollen at 35 days it was moderately red and at the end of the 52 days it was extremely red. Twenty-five cubic centimeters of corporin were given in the next 8 days. All injections were then stopped and the animal killed 42 days later (122nd day). By the sixteenth day after the stopping of all injections the sexual skin was pale and remained so.



Fig 12 Monkey 4 Higher magnification of Figure 11, showing atypical cells  $\times 205$

The cervix was retraumatized on the twenty first, twenty eighth, thirty ninth, fiftieth, fifty ninth, sixty seventh, seventy sixth, eightieth, ninety sixth, and one hundred and thirteenth days. On the ninety sixth day when the cervix was cut about 2 cubic centimeters of thick pus ran out. On several occasions the clip was found loose in the vagina but was reapplied each time.

At autopsy the cervix appeared white and nodular. Sections showed an atrophic sloughing epithelium. The vaginal epithelium was also atrophic. The uterus, removed at the time the injections were stopped, showed a hyperplastic condition of the endometrium. Since this animal was killed 42 days after all injections were stopped the atrophic condition of the epithelium would be expected. The sloughing was no doubt caused by severe infection.

**Monkey 8** This animal was a normal control with both ovaries intact. Cervical trauma only was given—no injections of any kind being made. The cervix was traumatized and a metal clip clamped on it. The trauma was then repeated on the eighth, eighteenth, twenty fifth, thirty sixth, forty seventh, fifty sixth, sixty fourth, seventy third, eightieth, ninety third, and one hundred and tenth days. The animal was killed on the one hundred and nineteenth day. The metal clip remained on the cervix throughout the experiment. The sexual skin was very red at the beginning of the experiment and remained so, indicating that the ovaries were actively secreting hormone throughout the experiment.

At autopsy the cervix was moderately nodular. Sections showed a few areas of columnar epithelium partially or completely surrounded by stratified squamous.



Fig 13 Monkey 9 Section of cervix from ovariectomized animal receiving only cervical trauma. Junction of stratified squamous epithelium with columnar cells Atrophic epithelium  $\times 55$

should be undertaken if necessary. This is probably the only way to distinguish those malignant conditions that will surely turn to malignancy later."

We have therefore been able to produce experimentally in the monkey a condition that occurs in the human cervix uteri. We believe that the squamous epithelium found around the columnar gland cells has arisen by a metaplasia of the columnar cells. We have not observed mitotic figures in either the columnar or squamous cells. This is probably due to the fact that the tissue was not taken at the particular time when mitosis was occurring.

Dr E. T. Engle, of Columbia University, has also observed areas of squamous cells associated with columnar gland cells in the cervixes of monkeys receiving only estrin (Ammio-in oil) injections.<sup>1</sup> His animals received daily injections for several months and the cervixes were not traumatized.

It should be possible by repeating these experiments and extending them over much longer periods of time to determine mentally whether the changes in question will or will not develop into cancer in the monkey. Either result would be highly important and view to demonstrating this point. To what extent the various experimental factors such as trauma, estrin, and corporin respectively are responsible for the results obtained also needs further analysis.

Monkey 9 This animal was an ovariectomized control. Both ovaries were removed, the cervix traumatized, and a metal clip clamped on it. No injections of any kind were given. Cervical trauma was repeated on the eighth, eighteenth, twenty-fifth, thirty-sixth, forty-seventh, fifty-sixth, sixty-fourth, seventy-third, and eightieth days. The animal was killed on the eighty-sixth day.

Sections of the cervix showed an atrophic epithelium, at no place was columnar epithelium either partially or completely surrounded by stratified squamous (Fig 13). Sections of the vagina and uterus also revealed an atrophic epithelium such as would be expected in an ovariectomized animal.

There is no agreement among pathologists who have examined our sections as to the exact significance of the epithelial changes produced in these experiments. In a preliminary publication (Overholser and Allen, 1933) it was stated that conditions resembling early cancer had been produced (Monkeys 3 and 4) based on the opinion of a well known pathologist. It appears that as yet there is no generally accepted definite criterion for the positive diagnosis of very early cervical cancer and that this accounts for the difference of opinion on this subject among pathologists.

The present confusion regarding the diagnosis of the precancerous state of the cervix uteri has been recently reviewed by Freedman (1934). He points out that the exact histological definition and diagnosis is still a matter of personal interpretation. Freedman presents sections of human cervical tissue that show excessive atypical overgrowth of new squamous cells along the walls of cervical glands and ducts that are exactly comparable to the conditions produced in these experiments (See Figs 3 to 12). He calls this condition "carcinoid" in preference to the term "precancerous," and states as follows: "The fact that we find it impossible to lay a perfect formula for the precancer stage does not preclude its existence. Study of the histogenesis of cancer would prove that there is such a precancerous stage, call it by whatever name is desirable. The fact that not all of these carcinoid tissues go on to actual cancer does not detract from their importance in the prevention of cancer, and a guarded attitude should be taken, frequent local examinations with biopsies to ascertain any progress toward malignancy."

## SUMMARY

Atypical epithelial growth in the cervix uteri of 4 ovariectomized monkeys (Monkeys 1 to 4) was experimentally produced. The changes consisted of marked squamous epithelial downgrowth, overgrowth and epidermization of the cervical glands in the region of the junction of the stratified squamous with the columnar epithelium. The treatment these animals received was as follows:

Monkey 1 received 5,490 rat units of estrin in 90 days with repeated cervical trauma.

Monkey 2 received 1,660 rat units of estrin in 20 days with repeated cervical trauma.

Monkey 3 received 4,747.5 rat units of estrin and 14 cubic centimeters of corpus luteum extract in 81 days with repeated cervical trauma.

Monkey 4 received 2,802.5 rat units of estrin and 10.7 cubic centimeters of corpus luteum extract in 84 days. This animal did not receive cervical trauma and the changes were very pronounced (Figs 11 and 12) the epithelial cells being very atypical.

In three monkeys the results were practically negative possibly due to the following reasons: (1) injection period too short (Monkey 5), (2) sloughing of epithelium from severe infection (Monkey 6), (3) sloughing of epithelium from infection and from stopping hormone injections 42 days before sacrificing animal (Monkey 7).

A normal control (Monkey 8) receiving trauma only showed a slight amount of epidermization of cervical glands.

An ovariectomized control (Monkey 9) receiving trauma only was completely negative.

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## THE ORIGIN OF PILONIDAL SINUS

WITH AN ANALYSIS OF ITS COMPARATIVE ANATOMY AND HISTOGENESIS

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THIS paper records the results of a study of pilonidal sinuses (also known as sacrococcygeal fistulae) and presents evidence that they are derived by a process of ectodermal invagination.

Contributions to the nature and origin of

pilonidal sinuses have been few, and are chiefly by investigators on the Continent. Couraud, 1883, Stone, 1924 (37), and Westman, 1933, in reviewing the literature found that J. M.

Warren described two cases and believed that the lesion was the result of an alteration of

the polarity of growth of the hair follicle which grew inwardly from the surface and

pulled "its hole in after it." This idea was purely hypothetical and lacked any embry-

logical basis. Hodges 1880, who gave to the condition the name pilonidal sinus (meaning

nest of hair), also advanced a theory that this affliction was due to the ingrowth of hair in

the postanal region as the result of unclean habits and erosion of the skin. Wendelstadt,

quoted by Stone (37) and Lwing, reported a case containing skin and hair, and he believed

that the hair acted as a plug causing the retention of infected material in a fistulous

tract. Vaughan Gross, and others also held to the belief that the anomaly followed inter-

ception or inclusion by the integument of surface hair follicles. The earliest writers

advised surgical excision for treatment.

## THE NEUROGENIC THEORY

At present there are two prevalent theories

as to the causation of pilonidal sinus, first, that which traces the origin of the condition

to a persistence of coccygeal vestiges of the neural canal, and second, that which derives

the lesion by a process of ectodermal invagination. The adherents of the former theory are

in the majority. On the Continent the first to advocate this thesis were Tournay and Herr-

mann in 1887. These investigators made sec-

The next important contribution on this subject was made by F. B. Mallory in 1892

Mallory, in a review of the literature, attempts to reconcile the various viewpoints and pre-

sents microscopic sections of several embryos from 3 to 6 months old. He found rather con-

sistently a tubular structure lined with several layers of columnar or cuboidal epithelial cells

lying between the coccyx and the skin in the coccyx and the distal end of the coccyx. The main part of

the coccyx and the distal end of the coccyx are taken place at about the level of the third second vertebra.

"Aided by Grant from The Anna Fuller Fund"

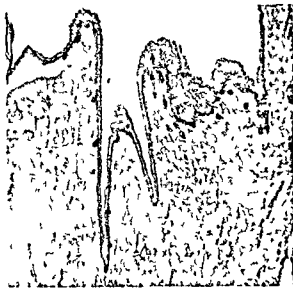


Fig 1 Path No 51806 Photomicrograph of a section through the caudal extremity of a white female 99 millimeter embryo (14½ weeks) Note the invaginations and the thickened epithelium in this region The clusters of cells beneath the epidermis later differentiate to form hair follicles and glands



Fig 2 Path No 51806 Photomicrograph of a section through the same embryo shown in Figure 1 but at a slightly higher level Note how closely the invaginating process approximates the coccyx The intervening tubular structure is a portion of the coccygeal vestiges of the primitive neural tube

the median line This canal lay in a region studded with glands and hair follicles and where ectodermal invaginations were a common and predominant feature in the development and regression of this portion of the human tail Mallory also came to the conclusion that the congenital depressions, dermoid cysts and sinuses found in the midline of the sacrococcygeal region arose from the persistence of medullary vestiges of the spinal cord The clinical finding of hair within the recesses of these sinus tracts was vaguely explained by the presence of neighboring dermoids or the migration of surface hair and foreign accumulations

Oehlecker, in 1926, also investigated these coccygeal vestiges of the neural tube His conclusions concerning the formation of pilonidal sinuses and cysts were as follows "Due to the rapid growth of the caudal, or non-vertebral portion of the cauda the caudal ligament puts traction on the thin hairless areas of skin overlying it in the sacrococcygeal region This traction is increased as the subcutaneous fat in this area grows and the caudal ligaments simultaneously become shortened

As a result of this traction the margins of the surrounding skin containing hair follicles are also to some degree invaginated The skin overlying the rapidly growing vertebrae being unable to keep up with the downgrowth of the vertebral column is displaced posteriorly and upward, as is also the tip of the caudal ligament By the fourth or fifth month the skin, which originally covered the tip of the coccyx is drawn upward so as to lie over the third or fourth caudal vertebra and later goes higher" (The point where the caudal ligament radiates into the skin makes a very thin hairless, vascular area which he calls sacral bald spot) "The normal products of the skin metabolism readily accumulate to form cysts or discharge intermittently as fistulae"

Thus the writer presupposes the coexistence of hairless and hair containing integument in the same region, and a special migration upward of neurogenic elements having lost their maternal connections and possessing no fixed point of attachment such as the spinal cord has with the brain at the foramen magnum If one supposes that the fixation point is the skin then the direction of the pilonidal



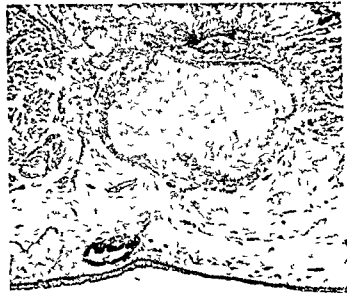


Fig 3 Path No 5202 Photomicrograph of a section through the coccygeal region of a white female, 101 millimeter embryo (15 1/2 weeks). The coccygeal medullary vestige is fully developed and lined with columnar epithelium. The ectoderm, however, is only slightly thickened and its appendages have not yet begun to appear



Fig 4 Path No 5200 Photomicrograph of a section through the coccygeal region of a white female, 132 millimeter embryo (17 1/2 weeks). Note the papillary folds of thickened ectoderm and the numerous clusters of cells in back of the coccyx

# THE THEORY OF ECTODERMAL INVAGINATION

The earliest proponents of this theory thought that pilonidal sinus was due to a dermoid cyst Lannelongue is quoted by Mallory as follows "After the medullary canal is formed, the mesoblast passes back between the vertebral column and the external epidermis except in the region of the sacrum, where little of this tissue is interposed, so that this region is reduced to epidermis and bone. Consequently, the superficial layer (epiblast) joined at a later period to the mesoblast pre-serves closer relations with the bone, and later, when the subcutaneous tissue is developed around these places, a depression will be formed. If deep and narrow enough, the orifice may close up, and a dermoid cyst be the consequence"

One of the first constructive contributions to the theory of ectodermal invagination as the cause of pilonidal sinus was made by Stone. In his first paper (37) in 1924 he reported 61 cases of which all were white, 16 per cent female, and the oldest was 49 years

and the youngest 18 years of age. Twenty-five cases had previous operations and some sinuses were of 10 to 20 years' duration. Following a personal communication with Dr George L. Streeter of the Carnegie Institute of Washington, Baltimore, Maryland, Stone came to the conclusion that the coccygeal medullary vestige, which has no opening communicating with the skin, consists of cells which have become so differentiated that they could not be expected later to give rise to skin, even though a cystic remnant should persist, and that like the breast and the external ear, the pilonidal sinus is due to a special local downgrowth of epithelium originating from the true skin and not from the medullary groove.

In 1931 Stone (38) in another paper upon the subject made the following observations. First, that in a few cases there were several congenital orifices, skin lined, and lying close together in or near the midline. Second, he



Fig. 3. Path No. 31810. Photomicrograph of a section through a colored male 168 millimeter embryo (20½ weeks) in the region of the coccyx. Note the persisting invagination and the developing hair follicles and glands. (The medullary vestiges are present but are not seen in this figure.)

discovered that in many species of birds there is described a preen or oil gland called uropygial gland which lies embedded in the subcutaneous fat over the last caudal vertebra. It consists of numerous straight tubules which converge and empty into a collecting chamber or small cavity which in turn empties through an epithelium lined duct onto the skin of the back. At the mouth of the duct there is often a tuft of fine hair like feathers. There may be several ducts (1 to 6 in number) and they lie in or near the posterior midline. The gland secretes an oily material which the bird conveys by its beak to stroke on its feathers, and the duct is directed in an upward direction like the pilonidal sinus in the human. This view quoted by the author from Lunghetti and Schumacher is contended by Paris who states that these are special scent glands concerned with protection and sexual attraction. According to

Paris, all amniotes, reptiles, and mammals as well as avians, have similar structures which are formed by inward budding invaginations of epithelium.

Thus, while a general agreement exists that some vestigial structure or anomaly in the embryo is responsible for the origin of pilonidal cysts, its exact nature is a matter of dispute. A re study of the sacrococcygeal region was therefore undertaken in human embryos to see if some structure could not be identified and more definitely associated with the lesion. Serial sections were made in seven embryos<sup>1</sup> through the caudal extremity from the anus to the region of the sacrum. Grossly, in the region just dorsal and cephalad to the anus in a 3½ months fetus, there could be seen with the naked eye and with low power lenses a pattern of grooves and creases which might well be taken for ectodermal invagination. A pit could be demonstrated in the 5½ months old embryo which was much deeper in the older specimens.

The first embryo was a 99 millimeter (14½ weeks) white female specimen. The activity of the invaginating ectoderm was very striking (Fig. 1). The epithelium in this region was markedly thickened and at various points beneath the epidermis clusters of budding epithelium, or growth centers could be seen. These were in the process of differentiating to form hair follicles and glands of the integument and were particularly active opposite the points of invagination. In Figure 2, which includes a portion of the coccyx, the peak of the invaginating process closely approximated the bone. Here also in the midline between the coccyx and the skin there was a tubular structure lined with columnar cells which was a portion of the coccygeal medullary vestiges (primitive neural tube).

This vestigial neural structure was more strikingly demonstrated in Figure 3 which is a section through a 101 millimeter (15½ weeks) white female embryo. Although this specimen was somewhat older than the preceding one, there was nevertheless a definite lag in growth and the skin appendages had

<sup>1</sup>These embryos were obtained for me through the kindness of Dr. George L. Streeter to whom I am indebted for his generous advice. The specimens were given to the laboratory by Dr. George L. Streeter who also kindly co-operated in this study.



Fig 6 Path No 52148 Photomicrograph of a section through the coccygeal region of a white male, 214 millimeter fetus (27 1/2 weeks). The invagination process is shown directly impinging upon the coccyx, and the skin appendages are very numerous and well developed.



Fig 7 Path No 52148 Photomicrograph of a section through the same fetus shown in Figure 6, but at a slightly higher level. Note the activity of the pilonidal cleft and compare with the fragmented, degenerating medullary vestiges.

There was only a suggestion of infolding and thickening of the ectoderm but the neural rests were larger and nearly completely developed. There seemed to be no relationship in these specimens between the development of the medullary vestiges and the process of ectodermal invagination. In the third specimen, the skin folds, and the skin appendages were beginning to cluster in back of the coccyx (Fig 4). The invaginating process persisted at 20 1/2 weeks (Fig 5) and the hair sheaths with their keratin centers were more prominent. (The medullary vestiges, though present, are not shown in this figure). It is evident that ectodermal invagination in this region varies in form and degree with different embryos. In other words, it does not proceed in graded steps in accordance with age in the first few months of embryonal development. However, at 27 1/2 weeks (Fig 6), or just before viability, the invagination increases in depth and impinges directly upon the coccyx and is prominent at this time. The skin appendages are now very numerous and well developed. (The surgical importance of this anatomical relationship will be stressed later). At this stage the ectodermal layer is twenty-five cells deep in contrast with the adjacent skin which is four to five cells in thickness. The hair follicles are also three to four times as abundant in the region of invagination. The medullary vestiges, however, are fragmented and the epithelium is degenerating (Fig 7). At 29 1/2 weeks, or after viability, the specimen showed only slight evidence of the pilonidal cleft or pit of invaginated ectoderm



Fig 8 Iath No 52150 Photomicrograph of a section through the coccygeal region of a white female 268 millimeter fetus (20½ weeks) The pilonidal cleft is shallow and the neural rests are being obliterated by an apparent ingrowth of fibroblasts and blood vessels



Fig 9 Path. No 52152 Photomicrograph of a section through the coccygeal region of a white female 226 millimeter embryo (26 weeks) Note the epithelial spur and the thickened ectoderm

This may be due to the lack of development but is very probably due to a recession of the invaginating process. On the other hand, the neural rests are being obliterated by an apparent new growth of fibrous tissue and an ingrowth of blood vessels (Fig 8). Curiously one specimen at 26 weeks showed a spur—between two invaginations of the ectoderm on either side (Fig 9). This brings to mind Lawson Tait's reference to the "human tail" but the resemblance is undoubtedly imaginative. In no specimen were the neural rests found to communicate with the spinal canal, although one could follow them through 125 to 400 serial sections each 7 microns in thickness.

In the chick embryo in the region of the sacrum may be seen an invagination of ectoderm forming the "glande du croupion" (40). This analogy is merely suggested and not stressed. At this writing it is desired only to present evidence that the forerunner of the

pilonidal sinus may be a specialized and transient skin appendage in the human the function and homologues of which in other species are as yet undetermined. Lawson Tait quoted by many authors, said that the sinus was due to the loss of a caudal appendage (human tail<sup>1</sup>), but made no mention of a skin appendage.

#### CLINICAL OBSERVATIONS

The clinical findings corroborate these embryological data, and one does not have to presuppose any special excursion of neurogenic elements or escalator migration of ectoderm over the bony coccyx.<sup>1</sup> In the first place pilonidal sinus is undoubtedly a congenital lesion although it becomes clinically evident practically always after the middle of the second decade. Rarely, a case has been reported in infants (28, 35).

<sup>1</sup>Dr Streeter states that there is no definite proof of the fact that skin migrates in this fashion over the sacrococcygeal region. Personal communication October 2, 1933.



Fig 10 Saccrococcygeal neuro epithelioma (glomus) (from Roussy et Oberling, *Atlas du Cancer*, Aug. 1931) The upper figure consists of cylindrical-cuboidal cells with fine vascular spaces containing red blood corpuscles. In the lower figure the cells are stratified and possess biliary extensions. These bundles represent neuroblastic differentiation in the tumor tissue

anthrax and actinomycosis and deep burrowing fistulous tracts may be ruled out within the scope of this paper, numerous recent articles have covered this phase of the subject.<sup>1</sup> The essential principle is block dissection with drainage, with or without partial primary suture. Location of adventitious sinuses tract with a mixture of methylene blue and hydrogen peroxide in equal parts (Stone, 38)

#### PATHOLOGY

The pathology is best illustrated by describing a case of a medical student 27 years of age, who was recently operated upon by Dr Stone. The specimen when received was 12

symptoms Likewise malignant infections like is essentially a benign lesion with benign inflammation, and by the fact that pilonidal sinus parts, of the anus or rectum, may be readily dismissed by rectal or sigmoidoscopic examination, and neoplastic lesions of the bony tuberculous, and reactions can be easily ruled out. Venereal, suppurations of bone with severe systemic abscesses and deep

in-ward, which is directed downward point in distinguishing the lesion from fistulation is usually upward, which is a differential and may reach the bone beneath. The direct, the sinuses vary in length and depth upon exerting pressure over the tract. When one may express drops of thin, dirty foul pus duration, and tenderness may be present and inflammation such as swelling, redness, incision of the tract. Signs of ectodermal invaginations (Fig 2) may communicate with one or more of the explained by the fact that the pilonidal cyst meter in diameter. These cases may be in size from a pin point to about 0.5 centimeters are not uncommon and they may vary trace is to be suspected. Several congenital opening in which case another point of intervention, or that it is an adventitious means that there has been previous operative irregular and covered with granulations, it hairs projecting outward. If the lumen is and from its mouth there may be seen fine, saccrococcygeal joint. It is smooth, skin-lined, usually in the midline in the region of the about it." The external opening is found so slight that the patient "never bothered symptoms are so mild and the inconvenience tion may reveal the sinus in cases in which the degrees of inflammation. A physical examination in the present series all show various 70 cases in routine examination—in over never found in routine examination—in over (sion) Uninfected pilonidal cysts are almost associated with meningitis (see later discussion) rarely found. These have occurred in cases nausea and vomiting, chill and malaise are but systemic reactions such as high fever, Localized tenderness and pain are common clothes or foul discharges near his rectum." The patient states that he has noticed "for some time an intermittent staining of his The patient states that he has noticed "for the transmission of a superficial infection. The initial symptom usually follows trauma

<sup>1</sup> Nelson's Surgery 29 Lewis's Surgery, 27 Taber's 19 Stone 17 Berre 3 Catell and Fowler 7 Dulligan 10 Landsman 20 Bookman 5 Weinman 44 Colp 8 Mason 27 Dr Stone uses hydrogen perox

ide to distend the adventitious tracts (personal communication)



Fig. 11. Path No. 8144. Photomicrograph of a sacral teratoma in a white female infant (age 1 day). It consists of numerous glands embedded in a delicate stroma of connective tissue. There are also adult and fetal cartilage, intestinal and bronchial epithelium, liver, brain, and neuroblastic tissue. Autopsy performed.

by 2½ by 2 centimeters. In the center was a large bifurcated opening leading into a tubulous tract which tunneled the entire specimen. At each end was an opening, one of which entered the main tract and the other led into a blind pouch of its own. These drainage points were irregular and surrounded by granulation tissue and obviously secondary in nature.<sup>1</sup> There were, however, two additional congenital lumens with smooth surfaces and each leading like a flask into a sac filled with hair and possessing a gelatinous lining. The hair was fine, silky, and lighter in color than the body hair. The main tract was lined with a velvety thin mucoid substance and contained long dark thick hairs. There was no frank pus and there were no hairs growing from the walls of the sinuses leading to the skin.

<sup>1</sup> Patient had a previous operation for pilonidal sinus in which two adventitious tracts were missed.



Fig. 12. Path No. 51574. Photomicrograph of a choroma in a white female 61 years old. The tumor consists of large round vacuolated hyperchromatic cells growing in a syncytial fashion and strongly resembling hyaline cartilage. The patient died with recurrence.

Histologically the picture of this and other cases is essentially the same. Usually the main tract consists of granulation tissue rich in blood vessels and exudate of a subacute inflammatory nature. There are some polymorphonuclear leucocytes, giant cells, and deposits of blood pigment, but predominating are large numbers of wandering cells—plasma cells, monocytes, and lymphocytes. Lying loosely in the stroma are numerous hairs without sheaths surrounded by giant cells. This is a very characteristic finding. Elsewhere one finds fully developed hair follicles and sweat glands. The adventitious branches are lined with stratified squamous epithelium like skin, but nowhere does one see the characteristic circumscribed structure of a dermoid. In fact, I have never seen a pilonidal sinus contain the cheesy substance, or the compressed epithelial lining and keratin

center of an epidermoid or subepithelial der-  
moid cyst

INCIDENCE AND POSTOPERATIVE RECURRENCES

Recurrences in cases of pilonidal sinuses are not uncommon. Most of them are due to the lack of understanding of the embryology and pathology of the disease with the result that incision and drainage is performed which is obviously inadequate. Stone<sup>1</sup> believes that recurrences should not exceed 5 to 8 per cent in good hands.

Cattell and Stoller from the Lacey Clinic report 59 cases with 9 recurrences in 40 traced cases. Six of these were cured by second operation. Landsman states that there are about 20 per cent recurrences in infection of the sacrococcygeal region. Stone (37) reported 61 cases from the Johns Hopkins records and private practice of which there were 25 recurrences. One patient had 8 or 10 previous operations. Dilligan reports 25 cases in Brooklyn, N. Y. It was his opinion that sacrococcygeal cysts were the result of congenital invagination of ectoderm with all its appendages, which if complete formed a cyst, and if incomplete formed a sinus or fossa.

Alanson reported 81 cases from the Mayo Clinic, during a 5 year period, of which 25 had multiple openings, but he does not state how many were recurrences. (Fifteen per cent in this series were females and the age group ranged from 16 to 57 years. There was 1 case in an infant of 19 months but this was not described.) Alanson states that trauma was a frequent finding in the history of these patients. Weinstein reported 13 cases, 85 per cent males and ranging from 17 to 39 years. Weeder, in a recent article, states that 25 to 35 per cent recurrence occurs in the best hands. This figure is probably too high for present day methods of treatment. This writer believes that if the theory of simple ectodermal invagination were true then all pilonidal sinuses should be cured by the first operation. But this is not as simple as it seems because there may be numerous congenital or adventitious tracts leading from the cyst, the entrance of which may be at the

<sup>1</sup>Personal communication.

time closed off to any injection of methylene blue and which may be missed with the naked eye. Weeder believes that recurrences are due to the inclusion within the sacrococcygeal junction of a part of the cyst, derived from the unobliterated portion of the medullary canal, during the process of fusion of the dorsal arches which may or may not be complete (spina bifida occulta). He noted that when he injected these cases with methylene blue the surface of the joint and occasionally even the deeper structures were discolored. In these cases, therefore, he recommends excision of the coccyx and curettage of the sacral stump. This procedure was performed in 4 cases, yet in none of these was there any mention of finding, grossly or microscopically, any inclusion cysts or cyst walls within the bony parts. We have had the opportunity to carry out Weeder's suggestion in only 1 case since his article was published (case described under "Pathology"). Sections through all the coccygeal joints revealed normal bone and joint structures. There was no evidence of inflammation or tumor or cyst inclusion. However, scattered along the sides of the coccyx were seen minute round vascular bodies like paraganglia consisting of polyhedral cells with densely staining nuclei surrounding blood spaces. These, of course, should not be confused with neural rests the epithelium of which is cuboidal or cylindrical and occasionally ciliated. Grossly, there was no evidence of invasion of the sinus tracts into the bony parts. Undoubtedly the discoloration of the joint, or of peristosteal or ligamentous structures, when found, is due to the trauma of a previous operation or damage by bacterial or chemical agents. Also, if Weeder's theory were true, a large percentage of the primary and all the recurrent cases should never have been cured. However, in this connection it should be stated that occasionally the sinus tract leads down to the coccyx (as was shown in Figure 6). In these instances the coccyx should be thoroughly trimmed of its peristosteal and fibrous covering. If the deeper structures are involved, especially in recurrent cases in which a peristosteal reaction may have been already set up, it may be safe and wise to

excise the coccyx. However, the danger of a low grade osteomyelitis complicating such a procedure was pointed out by Stone<sup>1</sup> following his case previously described. For this reason and also because in many cases the sinus is very superficial and may be limited to the level of the sacrum, it is felt that removal of the coccyx except in a few instances is not indicated.

#### A REVISED CLASSIFICATION OF CONGENITAL SACROCOCCYGEAL TUMORS

It is apparent that a different classification of tumors must be made on the basis of the embryological and histogenic character of the structures found in this region (Table I).

TABLE I—SACROCOCCYGEAL NEOPLASMS

	Tissue	Structure	Tumor
A.	Ectoderm	Epidermis	Pilonidal sinus dermoid cyst
B.	Neuroectoderm	Medullary vestiges	Solid neuroblastoma —fibroma cystic—adenocystoma
		Meninges	Meningocele
C.	Entoderm	Postanal gut	Neurenteric cyst, enteric cyst, dermoid cyst, carcinoma
D.	Mesenchyme	Notochord	Chordoma
E.	Undifferentiated tissue A B C D	Tail vestiges	Teratoma

1. *Pilonidal cysts* The pilonidal cyst is a congenital lesion due to a process of normal ectodermal invagination in the embryo, which usually disappears but in these cases has persisted in adult life. It commonly contains fine, silky, light colored hair, and mucoid or gelatinous material, is almost always infected, and its walls consist of several layers of epithelial cells with glands and hair follicles. Derived from budding or growth centers in the basal layer of the ectoderm which give rise to hair follicles and glands, it consists of cells which form only hair and glandular appendages. For this reason, one never sees teratomata, neurogenic growths, or heterologous tumors in pilonidal sinuses. The lesion becomes evident after the middle of the second decade and is probably associated with the development of secondary sex changes concomitant with puberty.

<sup>1</sup> Personal communication.

2. *Coccygeal medullary vestiges* F. B. Mallory (26) reported a glioma originating in the subcutaneous tissues over the coccyx, in a female age 44 years, which metastasized to both groins. Histologically, it consisted of small alveoli lined with epithelial cells embedded in a fairly abundant connective tissue stroma. Mallory, by differential stain, demonstrated coarse, wavy fibrils between cells which filled the alveoli, which were unlike connective tissue or smooth muscle fibrils. The tumor in the lymph nodes showed a papillary structure. Undoubtedly, this was a neuro-epithelioma, and probably arose from the neural rests which he and Hermann and Tournoux described. Mallory believed that it had the same origin as the pilonidal sinus.

Fowler described a huge cyst over the sacrum of a 2 months old female associated with bony defects of the sacrum and coccyx. The cyst repeatedly refilled following aspiration. Operation revealed no communication with the spinal canal but this might have easily been missed. The cyst was lined with ciliated cylindrical epithelial cells and was multilocular in character. The tumor was probably derived from a medullary rest of the primitive neural tube, its lining being similar to that of the neural canal in early embryonic life. Tumors of this type have no connection with pilonidal cysts.

Law, in reviewing the literature on pelvic tumors with sacral attachment, found only 30 cases and added a case of his own—a neuroblastoma in a female, age 27 years.

The coccygeal medullary vestiges may thus in rare instances give rise to large multilocular cystic or solid growths usually on the posterior surface of the sacrum and coccyx (Fig. 10). They may present anteriorly if the tumor is large or has invaded the pelvis. The large cystic masses nearly always occur in the newly born or young infant.

3. *Herniation of the cul-de-sac of the terminal meninges* Meningoceles present very little diagnostic difficulty, but the association of pilonidal sinus in cases of spina bifida complicated by meningitis has been used by certain writers to support the neurogenic theory.

Rupley and Thompson reported a case of pilonidal sinus with spina bifida in a 3½



"congenital cystic sarcoma." They are composed of closed vesicles lined with glandular epithelium and containropy mucus, or glue-like fluid (4). The epithelium consists of columnar and goblet cells, and one of the essential features for diagnosis is that the cysts have no serous or muscle coats (32). Middleдорpf is said to have been the first to recognize a tumor of this character. Ballantyne reviewed the literature on these tumors and added a case of carcinoma of postanal intestine in a female, aged 38 years. He found only 4 other cases reported. Huge dermoids and teratomas attached to the rectum or sacrum have been described (11, Fig. 11, 4, 17, 27).

Tumors of this group are usually single and always occur anterior to the coccyx and sacrum, may be confused with neurogenic growths, but have nothing in common with pilonidal cysts.

*5 Coccygeal gland* The coccygeal gland was originally described by Luschka in 1860. It was first thought to be a single body in front of the apex of the coccyx about 2.5 centimeters in size. In Quain's *Anatomy* the following histological description is given. It consists of masses irregular in shape and size which are very vascular, the vessels having a sinusoidal character. The cells of the gland come into close relationship to the sinuses with only a layer of endothelium between, indeed, the presence of this layer is not always easy of detection. Numerous nerves pass to the coccygeal gland and Luschka described ganglion cells within it, but this description has not been confirmed by modern investigation. Jacobson<sup>2</sup> believes that the mode of development probably connected with that of the sympathetic nervous system.

However (as was shown in Dr Stone's case) the coccygeal gland is only one of a number of paraganglia which are present in this region and which may give rise to paraganglioma tumors. Crawford Burns described a case of what he thought was a coccygeal body tumor. It was in a male, 22 years, who had a hard fixed mass in the sacrum the size of a fetal head and unattached to the rectum. The

The patient developed meningitis and died. Examination revealed a sacrococcygeal dermoid. The writers believed that the sinus arose from the vestiges of a neural tube. Aloise reported a case of a male 18 years of age who was admitted to the New Haven Hospital with headache and pain in the back. He had always had a sinus in the lower lumbar region of the back associated with an intermittent discharge of water fluid. Examination revealed a Staphylococcus albus meningitis with spina bilda occulta. Sacral laminectomy was done and effective drainage instituted. The patient survived and was discharged living and well. The author claims that the discharge was probably cerebrospinal fluid and that the sinus led into the dura but his evidence is circumstantial and inconclusive. The meninges can easily be explained by the lack of bony protection and by either the direct, lymphatic or metastatic extension of the infection particularly in cases of cystic spina bilda where the expanded subarachnoid space lies close to the skin (18). Moore has even reported a proved case of pilonidal sinus containing cerebrospinal fluid, one in which the sinus showed a direct communication with the spinal canal.

*4 Postanal gut and neurogenic canal* Certain anococcygeal tumors and cysts are said to arise from the remnants of the postanal gut and the neurogenic canal. In the early embryo the central canal of the spinal cord and the alimentary canal are continuous around the caudal extremity of the notochord (4). By this union is formed the neurogenic canal which subsequently atrophies and forms a fibrous cord. Hansmann and Ewing cite several cases of tumors containing intestinal wall and portions of nervous tissue which arose from these parts.

The postanal gut is formed as the result of the union of the invaginating portion of the proctodaeum, or primitive anus, with the intestine. Thus a segment of the intestine is left behind which atrophies and disappears. Occasionally in the newly born or young infants a vestigial structure remains which gives rise to cystic tumors situated anterior to the sacrum or coccyx. These tumors were formerly called

specimen which was removed at operation consisted histologically of polyhedral cells and numerous blood vessels. The cells were arranged in masses of irregular columns of a malignant nature. The growth subsequently recurred with large pelvic masses and was inoperable. Of course, one should not confuse these tumors which rarely metastasize with sacrococcygeal neuro epithelioma which are of high malignancy. On the other hand coccygeal paraganglioma should not be ruled out, as has been done (2), on account of finding a normal so called Luschka's gland, because "Luschka's gland" may be represented by a number of paraganglia in the coccygeal region a fact which is not generally recognized.

6 *Chordoma* These tumors are mentioned merely because they occur in the sacrococcygeal region and may be confused with the other groups. Their structure resembles hyaline cartilage, and mucin may be present. They may grow in an alveolar fashion and must be differentiated from myxochondroma and colloid carcinoma of the intestinal canal (Ewing—Fig 12). Fried and Stone described a case of chordoma which was treated for 9 years for a fistula in ano, perirectal abscess etc., and the true condition was not discovered until the case came under their observation and microscopic section had been made (Rankin, Borgen and Buie).

#### SUMMARY AND CONCLUSION

Evidence is presented from studies on the human embryo which indicate

1 That pilonidal sinus is a derivative of skin ectoderm and not neurogenic or enteric in origin.

2 That the structures forming the sinus are derived by a process of ectodermal invagination from the skin surface at the time and in the cells destined to form skin appendages (hair and glands) during the third and fourth months of embryonic life.

3 That its mode of origin, and the analogy drawn between this structure and the special "scent" gland in the sacrococcygeal region of birds and amniotes, suggest the probability that the sinus represents a vestigial skin appendage developing at puberty—hence the age distribution of pilonidal sinuses.

4 That coccygeal medullary vestiges exist is not denied, but they do not give rise to the pilonidal sinus. They probably give rise to the large cystic and solid tumors which occur usually in infants and the newly born. There is also the possibility that they may play a role in the upward direction which the pilonidal sinus takes.

5 Clinical and pathological findings are presented which are satisfactorily explained by this theory.

6 Other congenital growths of the sacrococcygeal region are described because of the sinuses and fistulae which these structures have produced—to clarify some of the confusion which has surrounded the history of their development. In this connection it is suggested that the coccygeal region may possess several sites for the origin of paraganglioma instead of only Luschka's gland as originally thought.

7 It is felt that recurrence following operation for pilonidal sinuses should take place in less than 10 per cent of the cases and is due to the fact that certain of the ramifications are left behind. Furthermore since the coccyx is fully developed in the first 6 weeks of fetal life and has no dorsal arches, and since the fourth and fifth sacral vertebrae have only vestiges of the neural arch, it is quite illogical to assume that the coccygeal medullary vestiges may be included within the sacrococcygeal joint. It is my belief that in operations for pilonidal sinus wherein the coccyx is removed and the sacral stump curetted, the improvement which is described is not due to the excision of included coccygeal medullary vestiges but due to the removal of the contiguous infection of periosteal or bony parts. One case is reported in which such an operation has been performed and in which no pathological changes could be demonstrated. Low grade osteomyelitis complicating such a procedure should be borne in mind.

8 In the prevention of recurrences it is suggested that wherever the sinus tract extends to the bony parts, the periosteal and fibrous layers should be carefully stripped off and curetted. Dead spaces and recesses with inflammatory products should be guarded against by preventing too early epithelial bridging of the wound and by careful packing.

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## FUNCTION OF THE LONG PLANTAR MUSCLES

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**T**HOUGH "the foot functions as a whole and the interactions of the several muscles form a complete unit which must be studied in its entirety," as stated by Halhsy, accident and disease tend to concentrate on individual muscles, and to correct the ill effects of these agents intelligently, the clinician must have an understanding of the manner in which individual muscles function. Medical literature yields very little exact information concerning the function of those muscles commonly referred to as the long plantar muscles. This dearth of detail is apparently due to the tendency of medical writers to consider the foot as the movable terminus of a fixed leg rather than in its more important function as a fixed base for support and propulsion of the body as a whole.

For example standard textbooks, such as those of Gray, Cunningham, Piersol and Spalteholz, give the function of the tibialis posterior as extension inversion, and adduction of the foot. Special studies of the motor system by Lovett, Wright, Mackenzie and others go little if any further into the subject. In German literature one finds a large amount of detailed and exhaustive investigation particularly in respect to muscle weight, cross section area, volume, etc., with considerable attention paid to these muscles in their relation to flat foot, but again adequate practical discussion is lacking.

Schlepe, in discussing flat foot due to traumatic section of the tibialis posterior tendon, attributes a primary rôle in sustaining the arch of the foot to this muscle. He finds that Hoffa, Schultz, Franke, and Frank support this contention, but that Lorenz and others deny it, that Nicolodoni finds this muscle important but not fundamental, while Biesalski, Fick, and Mayer ascribe the same function, and nearly equal importance in preservation of the arch, to this muscle and the flexor digitorum longus.

Meng, basing his argument on Weber's evaluation of muscle work from its mass, found by

cross sections of the long plantar muscles that in flat feet the flexor hallucis longus is one third weaker than in normal feet though the other muscles are practically unchanged. He regarded the flattening of the arch as the result of the weakness of this muscle and treated the deformity by shortening its tendon. Since a stretched muscle undergoes atrophy it is possible that Meng has confused cause and effect.

A muscle functions by contracting in length to approximate its points of origin and insertion. Either end may act as a fixed point toward which the other is drawn, or in regard to which it is stabilized. In general, muscle pull is exerted in a straight line between two points of attachment. In the muscles under discussion, direction of force is changed approximately 90 degrees by arrangement of bones and ligaments comparable to pulleys. Force is then exerted not only at the origin and insertion of the muscle, but upon the pulley, which tends to move according to the law of component and resultant forces.

The origins and insertions of the long plantar muscles have been sufficiently described by many anatomists. The relation of their tendons to the pulleys, and the rôles of the pulleys themselves in maintaining foot posture, have been largely ignored. The present purpose is a review of these details in relation to the preservation of foot posture.

The tibialis posterior has a large origin from the upper central area of the back of the leg. Its principal insertion is into the medial and plantar aspects of the navicular tubercle. Other strong fasciculi are inserted into the medioplantar portions of the metatarsal bases and into the tarsal bones anterior to the calcaneus and talus. Its tendon grooves the back of the medial malleolus and, under the tough ligamentum laciniatum, is separated from the medial surface of the neck of the talus by a thick fibrous pad. Its strongest insertion is into the tubercle of the navicular below and medial to the talonavicular joint.

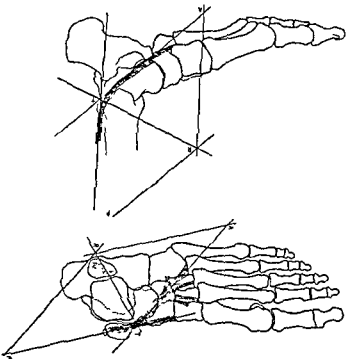


Fig. 1 In this and the following illustrations made from tracings of X rays of the foot in medial, lateral, and dorsal plantar views, with the tendons marked by wires, X marks the turn of the tendon about a pulley. The lines A-T and P-T represent equal forces anterior and posterior to the pulley, and AT the resultant force exerted on the pulley. The force actually applied to the pulley is a combination of the forces shown in the two views. It cannot be accurately represented in a two dimension figure. The tibialis posterior. When the foot is fixed in weight-bearing this tendon forces the inner malleolus forward, and lifts the head of the talus upward and outward. Loss of its support allows the malleolus to move backward, the talus and navicular to rotate downward and inward, and the foot to evert, particularly at the talonavicular joint.

medial to the subtalar talocalcaneal articulations and its tendon extends laterally to the outer toes, it also forces the talus outward on the calcaneus. Its power is expended primarily on the talus (Fig. 2)

The flexor hallucis longus arises from the lower and outer portion of the back of the leg and is inserted into the base of the terminal phalanx of the great toe. Its tendon, well away from the malleolus, traverses the groove on the posterior margin of the talus and is bound tightly in a fibrous tunnel on the medial surface of the calcaneus a half inch behind and lateral to the flexor digitorum tertius of the talonavicular joint, crosses above the flexor digitorum longus, to which it gives a slip, and extends under the first metatarsal parallel to the inner border of the foot. Its

Other fasciculi extend under the head of the talus to the anterolateral tarsal area. Contraction of this muscle approximates the navicular tubercle to the medial malleolus, inverting and plantarflexing the anterior segments of the tarsus on the posterior. When the ball of the foot is fixed in weight-bearing, the same force lifts the head of the talus upward and outward, at the same time forcing the malleolus forward. The arch sustaining power of the tibialis posterior is exerted primarily on the medial malleolus and navicular. The navicular rotates about an axis in the neck of the talus. The same force that inverts the navicular by traction on its tubercle will, when this bone is the more firmly fixed, evert the head of the talus, a motion abetted by forward movement of the internal malleolus (Fig. 1)

The writer is at loss for a term to describe accurately the motion occurring in the talonavicular and calcaneocuboid articulations. Together these joints comprise the transverse tarsal articulation. The talonavicular is a shallow ball and socket joint allowing motion in all directions, but its mobility is greatly restricted by the almost fixed calcaneocuboid relation. In this discussion the term inversion is used to denote that combination of medial motion of the foot with adduction of the anterior tarsus and rotation upward and outward of the talus head at the talonavicular joint

The flexor digitorum longus arises from the middle three-fifths of the inner portion of the back of the tibia and is inserted into the four outer toes. Its tendon crosses the articular line of the tibia lateral to the base of the malleolus and makes its turn in a strong ligamentous tunnel on the inner surface of the talus, behind, below and lateral to the tibialis posterior. It lies medial to the sustentaculum tali, passes under the outer half of the talonavicular articulation and beneath the joint between the second and third cuneiforms. In the sole it receives a reinforcement from the flexor hallucis longus which crosses above it. Its function is given as flexion of the toes, plantar flexion and inversion of the foot. With the ball of the foot fixed in weight-bearing, it lifts the talus and adjacent tarsal bones upward and forward. Because its tunnel is

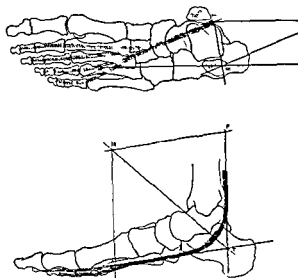


Fig 2 The flexor digitorum longus exerts an upward and outward lift on the talus and calcaneus. Loss of its function allows the foot to evert at the subtalar articulations and the longitudinal arch to sag.

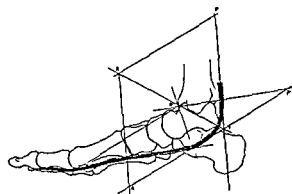
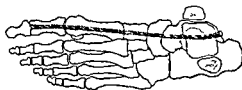


Fig 3 The flexor hallucis longus when the ball of the foot is fixed forces the talus forward and upward and lifts the anterior part of the calcaneus upward. The tendon turns first in a notch on the posterior margin of the talus then under the sustentaculum tali. Loss of its support allows depression of the midtarsus, and eversion at the talocalcaneal joints.

function is given as flexion of the great toe and plantar flexion of the ankle joint. In weight bearing its contraction lifts the anterior part of the calcaneus upward, forward, and outward, elevating the arch and inverting the foot. Its arch elevating power is exerted on the calcaneus (Fig 3).

The peroneus longus arises in the outer and upper part of the back of the leg and is inserted into the first cuneiform and the base of the first metatarsal. Its tendon turns behind the lateral malleolus, crosses the lateral surface of the calcaneus and base of the cuboid and extends diagonally across the sole under the cuboid and two outer cuneiforms. Under the cuboid it lies in a deep tunnel formed by the tuberosity of that bone and strong ligaments. Its function is commonly given as eversion and plantar flexion of the foot. With the foot fixed it presses the lateral malleolus forward and lifts the cuboid upward, inward and, by relation of its tendon to the anterior surface of the tuberosity, backward, thus supporting the outer border of the arch and, with the cross insertion of the tibialis posterior, consolidating the transverse tarsal arch (Fig 4).

The peroneus brevis extends from the outer and lower leg area to the base of the fifth

metatarsal. Its tendon is in direct relation to the lateral malleolus and, particularly when the foot is inverted, makes contact with the calcaneus and cuboid. Its contraction approximates the lateral malleolus and the fifth metatarsal base. It is not actually a plantar muscle, and has little function in weight bearing except in stabilizing the leg laterally. With the metatarsal fixed this tendon exerts a definite forward and lateral force on the fibular malleolus (Fig 5).

To compare the roles of these several muscles in actual weight bearing with the foregoing conclusions drawn from a study of their physical relationships a simple apparatus which may be described as follows was arranged. An ordinary bathroom scale was set upon a base board. A foot and leg, from which all soft tissues except the long muscles and the ligaments had been removed, was set upright on the scale. A small wooden block was placed on the upper end of the tibia, and on this another block with a nut on its under surface through which a bolt was screwed to impinge on the first block. The upper block was attached with wires to the base board. By

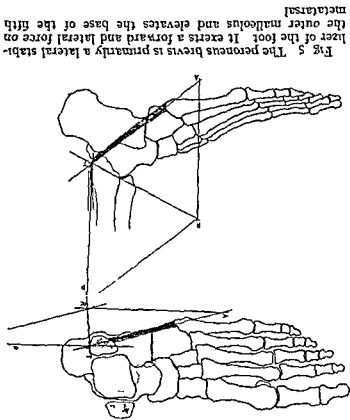


Fig. 5 The peroneus brevis is primarily a lateral stabilizer of the foot. It exerts a forward and lateral force on the outer malleolus and elevates the base of the fifth metatarsal.

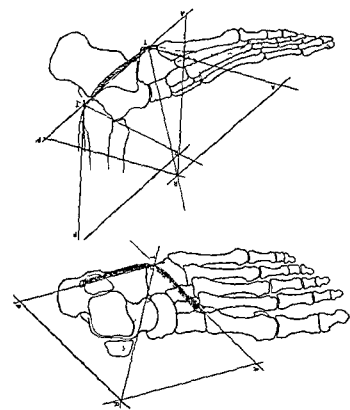


Fig. 4 The peroneus longus turns first behind the outer malleolus, which it lifts upward, inward and slightly backward. Loss of its function lowers the outer border of the foot and allows the foot to invert easily.

screwing the bolt down any desired pressure was registered on the scale. Strong sutures were placed in the tendons of each muscle, and other sutures in the muscles near their origins. Muscle tissue between the two sets of sutures was replaced by elastic bands, tension upon which was easily varied by adjusting the suture ties (Fig. 6).

It was found that in dissecting room material the arches of the foot could not be completely depressed without application of force sufficient to rupture the hardened structures. Therefore the plantar ligaments between each two bones were cut, relegating support of the arches to the long muscles alone. In this condition the weight of the leg was enough to flatten the arches.

Since little is known as to the actual force exerted by individual muscles in preserving normal foot posture, an arbitrary amount of 5 pounds was applied to each of the muscles under discussion. It was applied by interposing stretched rubber bands between the tendons and bellies of the muscles. By test

each was applied to the tendons of the tibialis posterior, flexor digitorum longus, flexor hallucis longus, and the peroneus longus and brevis. These produced plantar deviation of such an extent that weight bearing pressure could not be applied through the tibia to the foot. Similar pulls were therefore applied to the tibialis anterior and the extensor longus digitorum foot. The limb was then arranged in the apparatus as described, and subjected to weight bearing stress by screwing down the adjusting bolt. As pressure was increased the talonavicular and calcaneocuboid articulations gave way. The latter was completely depressed to the scale floor at 17 pounds, the former at 55 pounds. When pressure was again reduced the arches were restored.

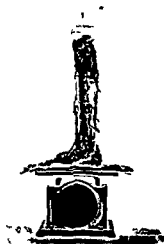


Fig. 6 Photograph of the apparatus used in Experiments 1 and 2 showing a leg and foot under adjustable weight bearing pressure. All plantar structures except the tendons under discussion have been removed and all ligaments cut. The arch is sustained by the rubber bands which replace the muscle bellies under pressure of 40 pounds.

Rotation of the leg forward on the ankle joint elongated the posterior bands while those of the anterior muscle group shortened. The added stress on the anterior portion of the arch from forward shifting of the weight was thus compensated by increased tension on the posterior tendons. In backward rotation of the leg the anterior bands stretched and the posterior shortened. "Tonus" of these rubber muscles thus adjusted itself to the varying stresses consequent upon the changing positions of weight bearing.

There is of course no reason to assume that the different muscles exert an equal force in preserving foot posture. The great amount of work done in determining cross section volume, mass and unit work values of muscles is of little practical importance as each of these muscles works under a different arrangement of pulleys and levers, so that a weaker muscle may actually accomplish more than a stronger one. Until the factor of leverages is added to the existing complicated tables of weights and measures the functional value of an individual muscle cannot be determined. The writer lacks the mathematical ability to estimate

these factors and questions the practical benefit to be derived, were he able to do so. The present effort is not concerned with determining the actual force exerted by the individual muscles, but with demonstrating first the particular role of each muscle, and second its relative importance, in maintaining foot posture.

*Experiment 2* One at a time the individual muscles were freed, tension being maintained upon the others.

With the tibialis anterior free the cuboid touched the scale at 13 pounds, the navicular at 48. The force of this muscle is exerted in a direct upward pull on the inner border of the longitudinal arch. Its efficiency is in direct ratio to its pull.

When the tibialis posterior was released the outer border of the foot reached the scale under 8 pounds pressure. With increasing weight the medial malleolus shifted backward, the head of the talus downward and the navicular was completely depressed when the scale registered 40 pounds. These combined movements resulted in a caving inward and downward of the mid tarsus. The weakening of the foot resulting from release of the tibialis posterior tendon was out of proportion to the 5 pound pull involved. The increase in force of this muscle is accomplished through the action of a virtual lever arm arrangement in the talonavicular articulation. The navicular glides about the head of the talus like a segment on the surface of a sphere. Its center of motion lies in the neck of the talus. The length of its lever arm is the radius of the sphere; that is, the distance from the center of motion to the tubercle of the navicular where the tendon of the tibialis is attached. When the navicular becomes the more firmly fixed the head of the talus glides upon it in a reverse direction.

With the flexor digitorum longus released the cuboid reached the scale floor at 10 pounds pressure, the navicular at 44 pounds. The malleolus advanced but little, more of the movement being accomplished by the talus.

Freeing of the flexor longus hallucis let the outer border of the foot down at 13 pounds, the inner border at 40, demonstrating a slightly weaker support of the lateral border



TABLE I.—RELATIVE EFFICIENCY OF THE DIFFERENT MUSCLES IN MAINTAINING FOOT POSTURE

Talaronavicular Calcanocuboid	Pounds pressure required to depress				
	With 5 pounds pull on each muscle	With tibialis anterior free	With flexor digitorum longus free	With tibialis posterior free	With peroneus longus free
17	55	48	44	40	55
23					
30					
43					
55					
75					

foot as a whole. The peroneus longus did the same with more efficiency.

The experiment demonstrated the usual textbook actions of these muscles. In a study and propulsion they are of minor importance

## DEDUCTIONS FROM STUDY

In studies of flat feet it is recognized that the long plantar muscles play leading roles in maintaining the longitudinal arch, that the tibialis posterior and peroneus longus through their cross insertion are also active in preserving the transverse tarsal arch, that the tibialis anterior is primarily a dorsiflexor and that the peroneus brevis functions primarily in stabilizing the leg on the foot laterally.

The tibialis anterior supports the fore part of the longitudinal arch. The importance of this forward support is demonstrated in those instances of metatarsus varus described by Peabody, and others, in which there is an abnormal insertion of this tendon at the metatarsophalangeal joint. Hallasy, in his study of the foot muscles, has recorded this as one of the more common variations in insertion of the tibialis anterior. In this condition the anterior tarsus sags laterally while the metatarsophalangeal area is held inward by the anomalous tibialis anterior and the hypertrophied adductor hallucis. Growth of the metatarsals under these abnormal stresses leads to distortion of their shafts. The writer treats this deformity by transplanting the anomalous tibialis to its usual insertion, and

of the foot by this muscle than by the flexor digitorum longus, but a stronger support of the medial border. Weakening of the foot from loss of the flexor hallucis longus was particularly noticeable in the subtaral articulation. The talus and navicular maintained their interrelation more closely than after loss of other muscles, but both rotated medially and downward along with the anterior end of the calcaneus to produce the simple eversion type of flat foot without pronounced mid-tarsal deformity.

The positions of the tendons of these last two muscles medial to the center of motion in the subtaral talocalcaneal joint give them a moderate mechanical advantage so that their actual pulls are increased somewhat in effect. Release of the peronei had no effect on the inner border of the foot. The outer border was depressed in each instance under 15 pounds.

This experiment demonstrated two means of support of the longitudinal arch, direct upward pull as exhibited by the tibialis anterior and peroneus brevis, in which work accomplished is in direct relation to the force applied, and second, lift from below as shown by the long plantar muscles, which is increased in effect by mechanical advantages of pulleys and levers.

*Experiment 3.* The leg being held stationary in a vertical position, the foot free, and all other muscles free, 5 pounds pull was applied to each muscle in turn.

The tibialis anterior elevated the inner border of the foot, then dorsiflexed the foot. The tibialis posterior adducted and plantarflexed the anterior part of the foot on the posterior, then inverted and plantarflexed the foot as a whole.

The flexor digitorum longus, in addition to flexing the foot outward, inverted and plantarflexed the foot, considerably increasing the arch by plantarflexing the fore part of the foot at the mid-tarsal joint.

The flexor hallucis longus inverted the foot less than the flexor digitorum, but plantarflexed it and elevated the arch by the same action at the mid-tarsal joint.

The peroneus brevis raised the outer border of the foot, then everted and plantarflexed the

freeing the adductor hallucis from its origin on the calcaneus by Steindler's method. With the faulty stress removed the bones straighten themselves without surgical mutilation.

The tibialis posterior functions in maintaining the malleolotalonavicular relationship in horizontal, vertical and sagittal planes. It is the only muscle acting directly on these parts and the only one that forces the medial malleolus forward. Its loss allows eversion and depression at the mid tarsal joint.

The flexor digitorum longus supports the arch by holding the talus upward, forward and outward in relation to the metatarsus and the heel. Loss of its support permits depression of the talus and inward rotation of this bone on the calcaneus, the simple type of everted flat foot.

The flexor hallucis longus maintains the arch by elevation and forward lift on the sustentaculum tali of the calcaneus. Its effect is similar to that of the flexor digitorum longus. Though it lacks the latter's lateral insertion it derives from its more medial position a greater power in lifting the inner border of the mid-tarsus. Its loss results in the same type of deformity as loss of the flexor digitorum.

The peroneus longus supports the outer border of the foot, consolidates the anterior

tarsus and stabilizes the foot and leg laterally. Its loss results in depression of the transverse arch and a tendency for the ankle to turn outward in weight bearing.

#### CONCLUSIONS

Each of the long plantar muscles plays a specific part in maintaining normal foot posture. Their individual roles depend more upon their relations to bone and ligament pulleys about the ankle than on their points of origin and insertion. Efforts to preserve or restore the arch must be based more than is ordinarily the custom on the particular need of the individual patient as determined by careful analysis of his disability.

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# THE BLOOD SEDIMENTATION TEST AND ITS VALUE IN THE DIFFERENTIAL DIAGNOSIS OF ACUTE APPENDICITIS<sup>1</sup>

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VARIOUS theories for the explanation of the phenomenon of blood sedimentation have been advanced, but the one which is almost universally accepted after considerable experimental investigation is that advanced by Fahræus, whose work gave renewed interest to a neglected subject. His opinion was that the determining factor in the sedimentation reaction is the seroglobulin and fibrinogen, both of which substances are present in the blood plasma in increasing quantities in the diseased states. This opinion has been recently confirmed by Gilligan and Linstene. Other factors, such as the adsorbability of the erythrocytes and carbon dioxide tension of the blood, are also mentioned but were shown to be of only secondary importance.

## TECHNIQUE

The original Westergren technique was first applied in our study of cases. This procedure was as follows: 4/10 of a cubic centimeter of 3.8 solution of sodium citrate was drawn up into a 2 cubic centimeter syringe, with this same syringe, blood was then taken from a vein to make a total of 2 cubic centimeters. After placing this blood in a test tube and shaking, the citrated blood was drawn into a glass tube 2 millimeters in diameter to make a column 200 millimeters in height. This glass tube was placed in a rack and readings of the level of sedimentation of the blood were taken every 10 minutes up to the final hour reading. In doing a large number of cases routinely on admission it was found necessary to modify this technique for purposes of simplicity and speed.

Our modification, allowing accurate Westergren interpretation, was devised as follows: Test tubes are prepared, each containing 30 milligrams of dried sodium citrate, these tubes are kept available in the wards at all times. To perform the test, 4 1/2 cubic centimeters of blood are drawn from a vein, added to a test tube, and shaken thoroughly, the test then proceeds as follows: The acute, full blown case, regardless of type, showed an average reading of 80 to 100 millimeters in the hour and with beginning resolution and convalescence the study of cases showed a gradual decrease in the sedimentation reading. With the onset of

6 millimeters to 15 millimeters in the hour—normal reaction  
25 millimeters to 40 millimeters in the hour—moderate reaction  
60 millimeters to 80 millimeters in the hour—high reaction  
80 millimeters to 140 millimeters in the hour—extreme reaction

## CLINICAL CASE GROUPS

In the latter part of 1931, we began to study the blood sedimentation rate in various types of cases in the wards at the Metropolitan Hospital. Our initial interest was to observe the relationship of this sedimentation reaction to the leucocytic response of the blood. These cases finally divided themselves into several large groups on a clinical basis. Two thousand cases, both medical and surgical, were studied, aligning themselves into the following groups:

1 Pneumonia and complications

2 Tuberculosis

3 Rheumatic fever

4 Pregnancy and complications

5 Acute and chronic salpingitis (adnexal disease)

6 The acute surgical abdomen, with stress on differential diagnosis of conditions in the right lower quadrant

1 Pneumonia and complications

In general, the study of 60 cases, with an average of 5 weekly readings in each case, revealed a definite index to prognosis in the course of the disease. The acute, full blown case, regardless of type, showed an average reading of 80 to 100 millimeters in the hour and with beginning resolution and convalescence the study of cases showed a gradual decrease in the sedimentation reading. With the onset of

complications such as pleurisy, empyema or pericarditis a sudden sharp increase in sedimentation rate was noted.

2 *Tuberculosis* In pulmonary tuberculosis we have found that the height of the sedimentation reading is an accurate indication of the extent and activity of the pulmonary pathology. Similarly in tuberculous peritonitis high sedimentation readings were obtained. Fifty cases were studied our interest being chiefly in allocating various types and degrees of pulmonary pathology in our sedimentation classification. Repeated readings were not done and indications as to prognosis and treatment were not investigated. Hilary Roche recently contributed an excellent paper on the blood sedimentation with particular reference to its relationship in the course and management of the condition.

3 *Rheumatic fever* Forty cases were studied at regular intervals averaging five readings to the case. During the acute clinical phase of the disease the average reading noted was 90 to 100 millimeters in the hour. Here it was found that in taking weekly readings the sedimentation time gave us a definite prognostic indication as to the course of the disease that is with regression of the disease as noted by improvement of joint symptoms, temperature etc. there was a definite decrease in the blood sedimentation reaction or with further complications such as increase in joint involvement or cardiac complication the high sedimentation reading persisted or even increased. Bach and Hill and Ernestine have made similar observations.

With reference to acute rheumatic fever and its abdominal manifestations particularly in children it is interesting to dwell on a paper by Plimpton Guptill in which he decries the need for a method or means to be used in the differential diagnosis of abdominal manifestations of acute rheumatic fever from acute appendicitis. The paper quotes a number of cases with an apparent clinical diagnosis of acute appendicitis which were operated upon, only to reveal normal appendices and which subsequently developed fulminating multiple joint symptoms. He remarks "These cases serve to illustrate the difficulties encountered in differentiating appendiceal

inflammation from the pseudo-appendiceal symptoms of rheumatism especially in view of the fact that Rolly in a series of 3,500 cases of rheumatic fever studied found evidence of peritoneal inflammation in only 2 cases and in neither of these 2 cases was there any involvement of the appendix. It is evident in view of the negative findings in the appendix that the clinician must reconsider the means of diagnosis in the hope that some sign will be developed to differentiate these two diseases.

We feel that we can offer a very substantial and satisfactory aid to this problem in the form of the sedimentation reaction. Every case of rheumatic fever in our study even at its earliest incipient stage, showed a sedimentation reading ranging from a high (60 to 80 millimeters in the hour) to a severe (70 to 140 millimeters in the hour) reaction. On the other hand every case of appendicitis studied showed an absolutely normal reading (6 to 15 millimeters in the hour). This rather peculiar phenomenon will be discussed in greater detail further on in the paper. It is interesting to quote an illustrative case.

L. B. colored male aged 12 years, was admitted to the hospital with a diagnosis of acute appendicitis. The onset of illness was with pain in the epigastrium 4 days previous to admission, followed by anorexia, listlessness and nausea. This pain shifted just before time of admission to the right lower quadrant. On admission temperature was 101 degrees, pulse 120 respirations 20. There was marked tenderness over McBurney's point and evidence of peritoneal irritation. Rectal examination was confirmatory, but no masses were palpated. The white blood count was 10,700 polymorphonuclears, 83 per cent band cells, 3 per cent. The sedimentation rate was 104 millimeters in the hour. Because the blood sedimentation reaction was so discordant with that consistently observed by us in acute appendicitis, it was decided to observe the case further. Two days later all abdominal pain disappeared and the patient complained of pain in the right hip. In several hours this was followed by the appearance of an acute painful swelling in the right knee.

In this case we feel that the diagnosis of the abdominal manifestations of acute rheumatic fever was properly differentiated from acute appendicitis with the aid of the sedimentation reaction.

4 *Pregnancy and complications* It has been well established since the first observation of

readings were taken at weekly or bi-weekly intervals to determine (a) progress of case under treatment, (b) optimum time for operation in those cases in which clinical history and pelvic examination so indicated. It was consistently observed that long after temperature, white count, pain and tenderness had subsided the more delicate sedimentation reaction became a much more accurate prognosticator as to the most favorable time for operation. No case was operated upon for adnexal disease until the sedimentation rate was below 25 millimeters in the hour. As a result, at no time in several hundred operations were acute processes encountered. This observation was well supported by an excellent record of low postoperative morbidity. A sharp contrast in morbidity and postoperative convalescence was seen in those cases operated upon for adnexal disease (before sedimentation readings became routine) in cases in which only clinical and other laboratory findings were used as indication for operation. Several of these cases ran stormy convalescent courses in spite of apparently favorable operability.

6 *The acute surgical abdomen* The acute surgical abdominal cases admitted to the emergency wards presented an interesting study in comparison of the sedimentation reaction with the leucocytic response. The first surgical emergencies on which the sedimentation test was done were those of acute appendicitis. Despite a definitely high leucocytic count in these cases, in which definite acute appendiceal pathology was demonstrated at the operation, we were surprised to encounter a normal sedimentation reaction. Such pathological states as catarrhal, suppurative, or gangrenous appendicitis caused no deviation from the normal sedimentation reaction. The only forms of appendiceal pathology giving abnormal sedimentation reactions were those of well established abscess, or generalized peritonitis of appendiceal origin. On the other hand, all other conditions producing the clinical picture of the acute surgical abdomen, showed a definitely abnormal sedimentation reaction. The abdominal conditions other than acute appendicitis in the order of frequency with

Fabrics that in pregnancy, beginning with the second month, there is a slow graded increase in the sedimentation reading, up to an approximate reading of 45 to 50 millimeters in the hour at term. In incomplete abortions, without sepsis, the blood sedimentation reaction is only slightly higher than that which is normal for the month of pregnancy, but with retention of secundines and with onset of sepsis, there is a sharp rise in the sedimentation time. In unruptured ectopic gestation, the reading is only slightly higher than that which is normal for the corresponding week of pregnancy. However, with rupture and free hemorrhage into the peritoneal cavity the sedimentation reading mounts to 80 to 100 millimeters in the hour, varying with the extent of hemorrhage. Friedlander similarly stated "ruptured ectopic pregnancy with fresh blood in the abdominal cavity had a range of acute infections."

5 *Acute and chronic salpingitis (adnexal disease)* Approximately one thousand cases were studied with a number of readings varying between 1 to 12 per case. This field of work has been thoroughly tilled by many investigators. Polak did a great deal of work along these lines and was highly convinced of the value and efficiency of this laboratory procedure in gynecology. Baer and Reis using the Lanzemeyer technique stated that a negative blood sedimentation reaction at the end of 120 minutes rules out pelvic infection. In our hands, the Westergren technique as modified seemed more accurate and more practical, indicating more clearly the gradations of pathology and necessitating only the hourly reading. A blood sedimentation reaction less than 20 millimeters in the hour was found to be an absolute assurance of the absence of any acute pelvic infection. On the whole, our results confirmed those of previous workers, and an optimum time for operation, as determined by the blood sedimentation rate, was found. All typical clinical cases of acute adnexal disease were found to have hourly readings varying from a low 40 to 50 millimeters to a high 140 to 150 millimeters depending upon the degree and extent of acute pelvic pathology. Sedimentation

TABLE I—CASE TABULATION OF ACUTE APPENDICITIS

Patient	Hospital No	Sex	Age	Pathology	W B C.	Per cent polya.	Sedimentation reading	
							15 min	1 hr
M V	40450	F	18	Acute suppurative appendicitis	17 200	79	6 mm.	15 mm.
E O	45566	M	32	Acute suppurative appendicitis	18 000	87	8 mm.	12 mm.
A B	24317	F	11	Acute catarrhal appendicitis	12 300	5	5 mm.	11 mm.
M A	4 835	F	33	Acute gangrenous appendicitis	12 400	84	1 mm.	4 mm.
M B	45268	F	22	Acute suppurative appendicitis	16 400	89	4 mm.	12 mm.
I B	40074	F	27	Acute suppurative appendicitis	27 600	91	4 mm.	11 mm.
J A	51541	M	19	Acute suppurative appendicitis	15 500	79	5 mm.	9 mm.
M M	54539	F	18	Acute gangrenous appendicitis	16,000	93	3 mm.	13 mm.
L E	14018	F	16	Acute gangrenous appendicitis	13 000	80	3 mm.	8 mm.
S W	47131	M	11	Acute suppurative appendicitis	12, 0	67	5 mm.	11 mm.
H W	48173	M	8	Acute suppurative appendicitis	7 400	70	4 mm.	12 mm.
T M	40575	M	7	Acute gangrenous appendicitis	1 400	67	4 mm.	12 mm.
C V	51079	F	6	Acute gangrenous appendicitis	14 000	80	3 mm.	7 mm.
M A	50898	F	17	Acute gangrenous appendicitis	10 200	76	4 mm.	8 mm.
M W	51234	F	45	Acute suppurative appendicitis	18 350	81	4 mm.	10 mm.
A N	52127	F	5	Acute catarrhal appendicitis	15 800	9	0 mm.	2 mm.
D E	52067	F	10	Acute catarrhal appendicitis	10 800	70	5 mm.	10 mm.
E H	5 166	F	12	Acute gangrenous appendicitis	15 400	82	2 mm.	9 mm.
D W	5 112	F	13	Acute suppurative appendicitis	10 500	70	0 mm.	8 mm.
G R	2258	F	9	Acute catarrhal appendicitis	10 500	4	3 mm.	11 mm.
T P	52220	M	13	Acute gangrenous appendicitis	17 660	91	1 mm.	5 mm.
T C	42038	M	1	Acute suppurative appendicitis	15 000	78	4 mm.	12 mm.
V G	526 9	F	19	Acute catarrhal appendicitis	12 200	74	1 mm.	11 mm.
P B	40999	F	12	Acute gangrenous appendicitis	20 000	90	8 mm.	12 mm.
P F	49013	M	3	Acute gangrenous appendicitis	15 300	8	10 mm.	15 mm.
H K	5330	F	3	Acute catarrhal appendicitis	12 200	8	1 mm.	7 mm.
N R	40 0	M	12	Acute suppurative appendicitis	16 600	82	4 mm.	9 mm.
M K	47428	F	13	Acute suppurative appendicitis	10 000	86	2 mm.	6 mm.
D S	53498	M	11	Acute gangrenous appendicitis	7,000	78	3 mm.	8 mm.
E B	34929	F	15	Acute catarrhal appendicitis	9 200	78	1 mm.	9 mm.
J V	36101	M	24	Acute suppurative appendicitis	10 050	88	0 mm.	2 mm.
L E	51994	F	22	Acute catarrhal appendicitis	10 100	88	3 mm.	7 mm.
L V	36301	M	30	Acute suppurative appendicitis	12 400	78	8 mm.	15 mm.
P L	54180	M	13	Acute suppurative appendicitis	15 000	87	1 mm.	9 mm.
J C.	54172	M	24	Acute catarrhal appendicitis	10 200	80	mm.	6 mm.
W D	5410	M	6	Acute catarrhal appendicitis	9,500	63	2 mm.	8 mm.
W G	54539	M	3	Acute gangrenous appendicitis	15,400	85	4 mm.	13 mm.
J K.	36114	M	50	Acute suppurative appendicitis	24 800	80	4 mm.	11 mm.
G V	35605	M	19	Acute suppurative appendicitis	11 800	81	3 mm.	9 mm.

TABLE I—CASE TABULATION OF ACUTE APPENDICITIS—Continued

Patient	Hospital No	Sex	Age	Pathology	W B C	Per cent leuko's	Sedimentation reading
E. C.	35703	M	35	Acute gangrenous appendicitis	12 400	81	15 mm
F. C.	36287	F	15	Acute catarrhal appendicitis	23 000	70	2 mm
C. H.	36817	M	52	Acute suppurative appendicitis	22 000	84	3 mm
A. E.	33770	F	18	Acute catarrhal appendicitis	7 800	84	2 mm
K. Z.	33968	F	19	Acute suppurative appendicitis	7 800	80	1 mm
M. E.	34018	F	16	Acute suppurative appendicitis	13 000	81	2 mm
J. B.	3500	M	35	Acute suppurative appendicitis	16 400	84	3 mm
M. C.	54160	F	8	Acute catarrhal appendicitis	10 000	78	3 mm
H. E.	54158	M	10	Acute catarrhal appendicitis	10 000	72	2 mm
A. S.	52723	M	34	Acute suppurative appendicitis	13 000	86	2 mm
D. S.	50224	M	26	Acute gangrenous appendicitis	17 500	87	3 mm
W. T.	50289	M	33	Acute suppurative appendicitis	13 600	80	2 mm
C. O.	51041	M	26	Acute suppurative appendicitis	23 500	84	3 mm
T. A.	51901	M	30	Acute suppurative appendicitis	22 500	89	3 mm
H. C.	51655	M	26	Acute suppurative appendicitis	15 000	84	3 mm
A. F.	52348	M	27	Acute suppurative appendicitis	13 900	94	3 mm
A. B.	54433	M	38	Acute gangrenous appendicitis	14 000	85	2 mm
L. Z.	53345	M	16	Acute suppurative appendicitis	15 000	89	2 mm
R. H.	54511	M	24	Acute gangrenous appendicitis	16 300	85	5 mm
J. B.	50900	M	43	Acute catarrhal appendicitis	14 400	86	3 mm
G. C.	52338	M	21	Acute suppurative appendicitis	17 800	80	5 mm
E. C.	51419	M	25	Acute gangrenous appendicitis	13 900	85	3 mm
T. P.	52720	M	19	Acute suppurative appendicitis	14 300	81	2 mm
H. R.	54073	F	36	Acute suppurative appendicitis	11 800	78	2 mm
M. C.	49332	F	16	Acute suppurative appendicitis	12 000	81	5 mm
A. F.	5442	F	20	Acute suppurative appendicitis	14 000	90	3 mm
D. L.	541 9	F	19	Acute suppurative appendicitis	10 400	86	2 mm
V. N.	On ward	F	8	Acute gangrenous appendicitis	10 600	78	3 mm
J. P.	On ward	M	10	Acute gangrenous appendicitis	12 800	70	1 mm
F. P.	On ward	M	21	Acute suppurative appendicitis	13 400	72	3 mm
T. S.	On ward	M	13	Acute suppurative appendicitis	16 200	88	2 mm
L. G.	On ward	M	21	Acute suppurative appendicitis	7 400	80	1 mm
T. V.	On ward	F	18	Acute suppurative appendicitis	10 000	84	2 mm
W. W.	On ward	M	10	Acute catarrhal appendicitis	11 800	65	2 mm
L. C.	On ward	F	24	Acute catarrhal appendicitis	12 000	83	3 mm
S. M.	On ward	F	9	Acute catarrhal appendicitis	8 400	60	3 mm
R. K.	On ward	F	34	Acute gangrenous appendicitis	12 000	82	34 mm
A. B.	55500	M	41	Acute gangrenous appendicitis	18 700	89	20 mm

These patients returned to tuberculous sedimentation after reaction due to bilateral cases and one month later showed the same blood sedimentation as pre-operatively. High blood sedimentation reaction after reaction due to bilateral cases and one month later showed the same blood sedimentation as pre-operatively.

TABLE II—CASE TABULATION OF CONDITIONS OTHER THAN ACUTE APPENDICITIS

## A Appendiceal Abscesses

Patient	Hospital No	Sex age	Pathology	W B C	Per cent polys	Sedimentation reading		Remarks
						15 min	1 hr	
L DeL	33746	F 41	Appendiceal abscess—appendix ruptured	5 500	78	20 mm	48 mm.	First operation abscess drained. Second operation (B S R 130 mm) subphrenic found and drained. Postoperative—B S R. gradually fell to normal
J W	54189	M 63	Appendix sloughed off—large abscess present	15 400	84	12 mm	57 mm	
J T	54495	M 38	Appendiceal abscess	13 400	84	10 mm.	80 mm	
C S	53117	M 14	Appendiceal abscess	16 000	88	11 mm	54 mm.	
T J	5769	F 35	Retrocecal abscess	13 600	76	4 mm	27 mm	
E D	53040	F 11	Appendiceal abscess	18 400	88	16 mm	33 mm.	
P A.	47633	F 10	Appendiceal abscess and gangrene of caecum	20 000	90	18 mm.	40 mm	

## B Generalized Peritonitis of Appendiceal Origin

M L	49914	F 33	Appendix ruptured—peritoneal fluid cloudy	16 000	88	7 mm	26 mm.	History of 16 hours duration
J M	34869	M 32	Appendix gangrenous—cloudy fluid free in peritoneum	17 200	83	10 mm	30 mm	
J P	859	M 9	Appendix ruptured	14 000	87	12 mm.	80 mm	Peritoneal fluid cloudy—positive B coli culture. Patient died
M B	217	F 44	Appendix ruptured	22 000	91	40 mm	90 mm	Free pus in peritoneal cavity. Patient died 2 days after operation
F H	53327	M 12	Appendix gangrenous	15 400	84	11 mm	35 mm	Moderate clear serofibrinous fluid in peritoneal cavity
H M	53851	F 28	Appendix ruptured	19 000	94	30 mm	70 mm.	Free pus in peritoneal cavity. Patient was 5 months pregnant. Aborted 1 month after operation
B K	44	M 64	Appendix ruptured	19 000	83	35 mm.	90 mm.	Free pus in peritoneal cavity. Patient died

## C Tabulation of Extra Appendiceal Conditions

D B	51178	M 38	Acute luteal apoplexy of liver	6 000	58	40 mm	137 mm	Pre-operative diagnosis was ruptured gastric ulcer
R S	368	F 11	Autopsy showed bilateral pleurisy with effusion	20 600	93	22 mm	104 mm	Patient operated on for appendicitis. Appendix normal. Patient died 5th postoperative day
M D	258	F 54	Ruptured gangrenous gall bladder with peritonitis	12 000	85	30 mm	96 mm	Pre-operative diagnosis was appendicitis. Patient died 4th postoperative day
R C	304	F 40	Operation revealed intestinal obstruction	19 000	88	30 mm.	70 mm	Pre-operative diagnosis was acute appendicitis. Appendix normal. Three loops of intestine found gangrenous. Resected. Patient died of postoperative pneumonia
T R	53491	F 14	Acute salpingitis	11 400	80	12 mm	55 mm	Pre-operative diagnosis was appendicitis. Operation revealed bilateral salpingitis
A C	53041	F 33	Acute pyocephalus demonstrated by cystoscopy pyelography	14 200	74	18 mm	50 mm	Admission diagnosis was acute appendicitis
M T	19822	F 39	Acute salpingitis	11 200	78	21 mm	63 mm	Pre-operative diagnosis was acute appendicitis
M C	53399	F 46	Acute cholecystitis cholelithiasis	13 700	74	40 mm.	82 mm	Admission diagnosis was acute appendicitis. Operation revealed gall bladder pathology
L M	47651	F 31	Acute cholecystitis	10 400	63	30 mm	72 mm	Stones present in gall bladder
A W	53648	F 18	Pleurisy with effusion	10 200	74	10 mm	70 mm	Patient operated on for acute appendicitis. Appendix found normal. Patient subsequently showed pleurisy with effusion
E W	52803	F 37	Strangulated femoral hernia	20 400	81	8 mm	47 mm	Admission diagnosis was appendicitis. Operation revealed strangulated hernia with hemorrhagic fluid



TABLE II—CASE TABULATION OF CONDITIONS OTHER THAN ACUTE APPENDICITIS—Continued

Patient	Hospital No.	Sex	Age	Pathology	W B C	Percent reading	Sedimentation 1 hr	Remarks
F P	43505	M	57	Ruptured duodenal ulcer	18 000	81	66 mm	Rupture in first portion of duodenum. Free intestinal contents in peritoneum.
J D	42162	M	56	Ruptured gastric ulcer	14 400	73	73 mm	Perforation on anterior surface of stomach.
M T	51579	F	24	Tubal pregnancy and hæmato-salpinx	12 300	84	70 mm	
V A	46379	F	31	Ruptured ectopic pregnancy	17 200	80	150 mm	Abdomen found filled with blood.
T S	14989	F	26	Tubal abortion	13 200	84	44 mm	Admission diagnosis acute appendicitis.
F 4	14377	F	30	Ruptured ectopic pregnancy	22 000	70	33 mm.	Moderate collection of blood in pelvis.
A F	55512	M	38	Gonococcus seminal vesiculitis	14 400	89	68 mm	Admission diagnosis was acute appendicitis.
A S	34406	F	36	Acute appendicitis with gangrenous cecum	18,500	90	67 mm	Admission diagnosis was acute appendicitis.
N N	535	F	46	Autopsy showed vegetable embolectasis and pericarditis	13,400	90	140 mm	Admission diagnosis was acute appendicitis. Patient died later on medical service.
M K	52089	M	40	Acute phlegmonous gall bladder	19 500	89	68 mm	
C. C.	51001	M	19	Tuberculous peritonitis	11 400	74	120 mm	
S G	33	M	33	Tuberculous abscess of liver	14 000	85	120 mm	Patient died after prolonged illness.
S T	42497	M	34	Ruptured malignant ulcer	12 500	80	40 mm	Period of comfort for 6 months following laparotomy. Patient died 1 year later.
H G	On ward	F	56	Ruptured gangrenous gall bladder	19 000	94	95 mm	Cholecystectomy done uneventful recovery.
G D	51919	F	19	Bilateral pyosalpinx	16 800	88	80 mm	
A W	51537	F	21	Bilateral pyosalpinx	14 100	81	65 mm	
J P	5400	M	65	Ruptured gangrenous gall bladder	13,400	81	35 mm	Cholecystectomy recovery.
J B	On ward	M	26	Casuous pneumonic tuberculosis	7 600	76	70 mm	Admission diagnosis was acute appendicitis.
A S	On ward	F	34	Ruptured ovarian cyst	10 500	81	25 mm	Admission diagnosis was acute appendicitis.

which they were found at the Metropolitan Hospital, were as follows

adnexal disease give a sedimentation reaction varying from high to severe (60 to 120 millimeters in the hour) depending upon the extent and virulence of the infection. This fact becomes one of utmost importance, especially so at this institution, where so many cases of acute adnexal disease are admitted with very vague history and clinical findings pointing to the right lower quadrant. The ordinary clinical and laboratory measures, in a good number of cases, have frequently left us undecided as to a definite diagnosis particularly between appendicitis and salpingitis. It soon became apparent that the sedimentation reaction offered us a new and distinct aid in the differential diagnosis in this classical dilemma.

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conditions yielding abnormal sedimentation readings, usually 75 to 90 millimeters in the hour

*Acute conditions of the genito urinary tract* Acute conditions of the genito urinary tract such as pyonephrosis, pyelitis, ureteral calculus, and seminal vesiculitis, have on occasion simulated acute appendicitis. In these cases the blood sedimentation reaction has been consistently high.

*Masked chest conditions with abdominal manifestations* That group of acute chest conditions with referred abdominal manifestations has also entered into a differential diagnosis of the acute surgical abdomen, thus several cases with apparently acute surgical conditions of the abdomen and high sedimentation readings have subsequently proved to have acute pulmonary pathology, such as central pneumonia and acute tuberculosis.

*Miscellaneous conditions with acute abdominal manifestations* Such conditions as ruptured ovarian cyst ruptured ectopic pregnancy, mesentery thrombosis and acute mesenteric adenitis have on occasion entered into the differential diagnosis of the acute surgical abdomen. These conditions have all shown definitely abnormal sedimentation reactions.

#### TABULATION OF CASES AND COMMENT

We have grouped the cases studied into the following tables. Table I consisting of all cases of acute appendicitis, Table II consisting of a group of other surgical conditions encountered.

Table I demonstrates a clinical, laboratory and operative study of 75 consecutive cases of acute appendicitis falling into the pathological classification of acute catarrhal, gangrenous and suppurative. It is uniformly observed that the sedimentation reaction regardless of pathology noted has been normal. Age, sex and casual individual factors do not alter in any appreciable manner the sedimentation reaction in this group of cases. The white counts are found to vary from normal (7,000) to 30,000 and the percentage of polymorphonuclears varies from 65 to 95 per cent without any bearing or relationship to the consistently normal blood sedimentation

reaction. In those cases in which Schilling or Arneth indices were done, no relationship to the sedimentation reading was noted.

Table II enumerates that group of cases other than acute appendicitis as proved at operation or by subsequent clinical course of the condition. A study of this group of cases illustrates the variety of conditions encountered in the surgical differential diagnosis of the acute appendix. The sedimentation readings were uniformly abnormal, regardless of the diagnosis. No consistent relationship between the white cell count and blood sedimentation reaction was noted, although in some cases, e.g., in extensive suppuration, high sedimentation readings were accompanied by high white cell counts. It is important to note that cases of appendiceal abscess are grouped under Table II inasmuch as such cases present a definite distinction, both on a clinical and pathological basis, from acute appendicitis *per se*. These cases have shown distinctly abnormal readings, varying from 40 to 100 millimeters in the hour, likewise, frank cases of generalized peritonitis, though appendiceal in origin, are grouped in the above table.

To demonstrate the value of the sedimentation reaction as an aid to differential diagnosis, we wish to quote several of the numerous cases encountered in which the sedimentation reaction proved to be a distinct guide to diagnosis.

CASE 1. D. L., a colored female child, 10 years of age, was admitted to the hospital with a diagnosis of acute appendicitis. Thirty-six hours before admission she was seized with severe pain in the epigastrium soon followed by nausea and vomiting. On admission the pain was described as having migrated to the umbilicus and lower right quadrant. Past history was essentially negative. On examination there was found marked tenderness in the right lower quadrant and slight spasm. The temperature was 99, pulse 100, respirations 22. The white blood count was 10,700—polymorphonuclears 71 per cent, the blood sedimentation rate was 40 millimeters in the hour. Because of aggravation of symptoms, laparotomy was done, revealing an acute salpingitis with normal appendix.

CASE 2. A. F., adult colored male, aged 24 years, was admitted to the hospital with a diagnosis of acute appendicitis. There was a history of pain in right lower quadrant for past 2 days with nausea but no vomiting. He had taken an enema and cathartic

chest, these findings were confirmed by X-ray, chest was tapped and patient placed under medical treatment

#### SURVEY OF THE LITERATURE

On completion of the work outlined, it was interesting to survey the contemporary literature on the subject. The references were comparatively meagre and on the whole discordant. M Cattaneo in 1932 studied 40 cases of acute and chronic appendicitis. His conclusions are completely contradicted by our results. He states "In subacute and chronic appendicitis, the sedimentation velocity of erythrocytes increases with the increase in leucocytes. In acute appendicitis, the sedimentation velocity increases also in those cases in which no increase in leucocytes appears—but as it seems more constant in acute cases and is earlier as compared to the leucocytosis, it may furnish useful indications in appendicitis—as to the existence of the inflammatory condition." It will be readily seen that the conclusions drawn by this writer in a short series including chronic cases is contradicted in every respect by our results. M Montanari-Keggiani studied the "Numerical variations of the leucocytes and the conduct of the sedimentation rate in cholecystitis, appendicitis and adenitis." We agree with his general observation that there exists in none of these infections a specific conduct or a correspondence between a degree of leucocytosis and the time of sedimentation, but we thoroughly disagree with his impression that no differential diagnostic data between these three diseases can be obtained. The essential purpose of our study after a two thousand case series is to clearly demonstrate the striking value of the blood sedimentation reaction in the differential diagnosis of appendicitis.

E G Bannick presents an excellent paper on the sedimentation reaction covering a wide variety of conditions. His generalizations are concise, and our studies concur in every respect with his results. We have independently concluded, as he does, that "the chief information concerning the rapidity of the sedimentation of the blood is provided during the first hour—and the simplest way of expressing this is by measuring in millimeters

On examination the patient was found to be acutely ill, temperature was 100, pulse 100, respirations 22. There was spasm and tenderness with hyperreflexia of the right lower quadrant. On rectal examination, an acutely tender boggy seminal vesicle was palpated on left side. On further questioning, the history was obtained of gonococcal arthritis 4 years previously with recurrent of slight urethral discharge 1 month ago. The white blood count was 10,400, 75 per cent polymorphonuclears, blood sedimentation rate 65 millimeters in the hour. The urine showed moderate pus cells and shreds. The patient was transferred to genito-urinary service where he underwent treatment for seminal vesiculitis with relief of condition.

Case 3 J B, Porto Rican male, aged 26 years, was admitted with diagnosis of acute appendicitis. Three days before admission patient began to suffer severe right lower quadrant pain followed by nausea and vomiting. On examination, patient appeared acutely ill, temperature was 101, pulse 120, respirations 22. There was marked muscle spasm and tenderness in right lower quadrant. The white blood count was 7,600, polymorphonuclears 67 per cent, blood sedimentation rate 70 millimeters in the hour. Further examination, with X ray and fluoroscopy, revealed an acute caseous pneumonia tuberculosis of the right apex, despite the fact that there were no symptoms referable to the chest. Shortly thereafter, the abdominal symptoms subsided entirely, and the patient is now receiving pneumothorax treatment.

Case 4 W C, 32 year old married Porto Rican female, was admitted with diagnosis of acute appendicitis. There was a history of recurrent attacks of pain in right lower quadrant, the last attack being of 24 hours' duration. The temperature was 102 degrees, pulse 110, respirations 24. There was tenderness, spasm, and rigidity over right lower quadrant extending posteriorly to the flank. The white blood count was 13,400—88 per cent polymorphonuclears, sedimentation time 114 millimeters in the hour. The urine showed albumin 3 plus, occasional red cells and moderate pus cells. Cystoscopy and pyelography revealed a pyohydronephrosis with stones in pelvis.

Case 5 A W, white female, aged 17 years, was admitted to hospital with diagnosis of acute appendicitis. There was a history of an attack of pain in right iliac region radiating to right lower quadrant 1 day previous to admission, there was nausea but no vomiting. The patient had had similar spasmodic attacks of pain during the past 2 years. On examination, patient appeared acutely ill, temperature was 103 degrees, pulse 114, respirations 24. The abdomen revealed tenderness and spasm below and to the right of the umbilicus. The white blood count was 10,200—76 per cent polymorphonuclears, blood sedimentation rate 70 millimeters in the hour. Appendectomy was performed and appendicitis was found to be entirely normal. After operation, the patient developed signs of increasing fluid in the right



TABLE III—AGE AND SEX IN SKIN MALIGNANCIES

	6	9	16	19	20	21	22	23	24	25	26	27	28	29	30	M	f
Basal cell epithelioma						2			4				2	2	2	6	4
Squamous cell epithelioma	1		1			1			1	1		1	2			6	2
Virus cell carcinoma									1			1	2			8	1

These skin malignancies were treated by means of unfiltered X-rays, two to five times the erythema dose, in one sitting, radium lymph nodes in the squamous cell cases were treated by means of 200 milloivolt X-rays or large radium packs. In some cases surgery or coagulation was resorted to according to

There were 9 cases of nevus cell carcinoma. Three of these patients gave a history of a growth of a mole which had existed since birth. Only 1 patient gave a history of injury at the site of the lesion. All the lesions were removed surgically and treated with 200 kilovolt X-rays or radium packs. The result of this treatment is as follows

One patient is alive and well 9 years 5 months after treatment, 1 patient was clinically well for 2 years 5 months when there was a recurrence and he died 5 years 9 months after admission from general carcinomatosis, 1 patient was well for 8 months and then there was a recurrence. He eventually died from the disease 3 years 7 months after admission. Four patients died within a year with no improvement, 2 were lost trace of in 6 months and 8 months respectively. Both were unimproved.

It is a fact that most basal cell and squamous cell epitheliomata, and also nasus cell carcinomata, occur later in life, the majority occurring after the age of 40

## ORBITAL CAVITY

There were 20 cases of malignancy involving the orbital cavity in patients under 30 years of age. Twelve were retinoblastomata (gliomata), 2 squamous cell epitheliomata of the conjunctiva, 1 basal cell epithelioma of

This patient had both lesions at the time of admission. Both healed with radiation treatment but the right one recurred after 3 years. The lesion was treated but the patient neglected the condition and did not report for re examination until the lesion was far advanced. Irradiation was again tried but was unsuccessful. Eventually the entire orbital contents and eyelids were coagulated, but the disease spread gradually, causing death 19 years after admission. The lesion on the other eyelid remained healed at the time of death.

Some varied from 6 months to 10 years. All but one of the lesions were treated successfully. That is, all healed following original treatment. One was lost trace of 1 month later, the remainder have been well for periods varying from 1 year to 18 years, with the exception of the patient who had two lesions, one on the left lower eyelid and one on the right lower eyelid.

The 10 basal cell lesions all began as small  
and 6 nevus cell carcinomata  
sores or pimples which did not heal. Two of  
the patients gave a history of a burn as the  
beginning of their present illness, and one,  
with a razor. The duration of these symp-  
toms varied from 6 months to 10 years.

Twenty-seven patients suffering from malignant disease of the skin were 30 years of age or younger. Of these, 10 had basal cell epitheliomata, 8 squamous cell epitheliomata, and 9 nevus cell carcinomata.

TABLE IV—AGE AND SEX IN ORBITAL CAVITY TUMORS

	Age												Sex	
	1	2	3	7	13	14	16	18	19	27	28	30	M	F
Retin blastoma (glioma)	2	5	3	1	1								9	3
Epithelioma conjunctiva								1	1				1	1
Basal cell epithelioma cornea							1						1	
Carcinoma lacrymal gland										1	1			2
Sarcoma	1					1						1	1	2

the cornea, 2 carcinomata of the lacrymal gland, and 3 sarcomata. Table IV shows the age and sex of these patients.

Retinoblastoma is a disease which usually occurs in children. Most of the cases occur before the age of 5 years. Usually parents or guardians discover some abnormality in sight from the actions of the children and finally notice a dilated pupil with a grayish color. These symptoms were noted as early as 6 weeks after birth in our group of cases. In 1 of our cases, 83 per cent, the disease was bilateral. Stout quotes Morax as saying that 28 per cent of these tumors are bilateral.

If seen fairly early there is a fair prospect of surgical cure. When the disease has permeated the globe (the glaucomatous stage) or penetrated the globe, the prognosis is grave. Stepha, as quoted by Stout, says that in all cases where it had perforated the globe the results were bad. Ten of our cases had had enucleation of the affected eye. All were treated by radiation either 200 kilovolt X-rays, or radium applications. Light died in less than a year, 1 was lost trace of in 3 months, the result undetermined, 1 was lost trace of 2 years after admission, at which time there was no recurrence, 1 was clinically well for 9 months and then lost trace of, and one has been clinically well for 3 years and 4 months following surgical removal and irradiation.

Both cases of squamous cell epithelioma of the conjunctiva were biopsied and treated with a large amount of radon lightly filtered and have remained clinically well since the time of original treatment. The one, a 19 year old male, for 10 years, the other, an 18 year old female, for 2 years.

The basal cell epithelioma of the cornea occurred in a 16 year old male. This lesion was biopsied and treated with a large amount of radon lightly filtered and has remained clinically well for 1 year and 7 months since treatment.

The 2 carcinomata of the lacrymal gland were tumors of the mixed salivary type. Both were treated by radiation followed by surgical removal of the tumor. One patient died in 2 years from metastases throughout the skull and scalp, and the other patient lived over 6 years and was free from recurrence at last observation. Both were females, aged 27 and 28 years, respectively.

The 3 other cases of malignancy involving the orbit were sarcomata.

One was a round cell sarcoma in a 15 month old female. The eyeball was enucleated and the tumor removed but the baby died the following day. Autopsy revealed metastases to the lungs, kidneys and bladder.

The second case was in a 14 year old male and biopsy showed a mixed cell sarcoma containing spindle, round, and myxosarcoma. The tumor was dissected from the orbit and radium needles were inserted following which he was clinically well for 7 months. The lesion then recurred and was again treated with the insertion of radium needles and the application of the 4 gram radium pack. He has been clinically well for the past year.

The third in a 30 year old female was a melanoma sarcoma which was treated with 200 kilovolt X-rays followed by enucleation of the eye. This patient died 4 years 6 months after admission, from recurrence of the lesion in the orbit and spinal metastases.

#### BRAIN

There were two brain tumors. One was a cerebellar tumor in a 6 year old male on whom a decompression had been done before admission. This child complained of headaches, and

loma. The histones given were of a growth or size which had been noticed for from 2 months to 2 years. All of these lesions involved a large area. Two of the patients were treated with radium applied to the lesion and 1 of these also had excision of the whole lesion, the third was treated with 200 kilovolt X-rays only. All died within a year.

There were 5 cases of adenomatous of the jaw in patients aged 4, 12, 14, 25, and 25 years, 2 were females and 3 were males; the lesions occurred at the site of carious teeth or some abnormal dental condition.

The lesion in the 12 year old female was not treated the rest had removal of the tumor was followed by radium application.

The 4 year old male was lost trace of in 1 year 11 months, the lesion had progressed.

The 14 year old male died 10 years 9 months after admission. The tumor had grown very large, ulcerated, perforated the cheek, and caused a large swelling at the side of the head, but he had had palliation for a number of years. Resection of the jaw had been reserved in this case.

The 23 year old male was clinically well for 1 month when he was lost from observation.

The 25 year old female, a colored woman, was clinically well for 3 years. Since then the lesion had recurred on 3 occasions. Curettage and irradiation have been palliative over a period of 10 years.

The case, a 17 months old male, had an injury to the jaw followed by tumor formation. Section of the jaw followed by complete disappearance of the tumor. The baby died 2 1/2 months later from other causes. A hyperostosis of the gum occurred in a 3 year old male and involved the jaw bone. This was removed surgically and then treated with 200 kilovolt X-rays and there has been no recurrence for 3 years 9 months.

An alveolar sarcoma occurred in a 29 year old female. This was treated with a large amount of radium, blotted, and the implantation of radon seeds. This patient has been clinically well for the past 3 years.

Four of these malignancies of the oral cavity occurred on the palate.

One was an epithelioma in the soft palate area with a palpable nodule in the right submandibular region, in a 25 year old male. The lesion was treated by the implantation of gold radon seeds and the nodes in the submandibular region were treated with 200 kilovolt X-rays. This patient has been clinically well for 3 years.

had been troubled by nausea and vomiting for 3 months. He was treated with 200 kilovolt X-rays and he died 3 months after admission. The second case was a medioloblastoma of the floor of the mouth ventricle in a 12 year old female. Tissue had been removed at the time of admission and 200 kilovolt X-rays were given. This child had palliation for 7 months, when there was a return of her symptoms and progression of the disease and she died 1 year after admission.

## LIP

There were 4 cases of epithelioma of the lip (10), in patients aged 25, 27, 28, and 29 years, respectively. All were males. In 3 the lesion was confined to the lip and there were no palpable nodes in the neck, in the mouth, there were small nodes in both the right and left submandibular regions. All of these patients used tobacco and all had poor oral hygiene, 2 had positive Wassermann reactions. The sections in all the cases were found to be squamous cell epithelioma. All have remained well since treatment except that 1 still has a small palpable node in the submandibular region, 1 remained well for 2 months and was then lost trace of, 1 for 6 years, 1 for 8 months, and 1 for 7 months (this is the one with the node). These cases were treated with unfiltered X-rays to the lip and 200 kilovolt X-rays to the lymph bearing areas. These patients gave histories of a cold sore, scabbed lesion, or small ulcerations which had existed for from 3 months to 1 year.

## ORAL CAVITY

There were 23 cases of malignancy involving the oral cavity in which the patients were under the age of 30 years. One was a papilloma like growth inside the upper lip in a 23 year old female which showed beginning epithelioma and was treated by the implantation of radon seeds. The tumor regressed following treatment but the patient was lost from observation.

There were 11 cases of malignancy of the gum, 3 were epithelioma in 18, 22, and 26 year old males, all used tobacco, oral hygiene was fair; one had a positive Wassermann reaction. Boys in the 3 cases showed epithelioma.

TABLE V—AGE AND SEX—ORAL CAVITY AND LIP MALIGNANCIES

	Age																														Sex	
	2	4	5	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	M	F						
Epithelioma								1				1				1	1	1	1	1	1	1	1	1	1	1	1					
Adamantinoma		1				1		1											1			1										
Sarcoma	1		1	1							1							1	1	1	1		2									

### Two were myxosarcomata

One occurred in a 29 year old male and involved the hard and soft palate regions. He was treated with radium packs but died 11 days after admission from acute dilatation of the heart. Autopsy revealed that this lesion had invaded the bone.

The other myxosarcoma occurred in a 10 year old female and involved the soft palate with a peritonsillar node on the right side. This patient remained clinically well 2 years 11 months following treatment with 200 kilovolt X rays but the lesion then recurred causing her death 3 years 4 months after admission.

The fourth case was a fibrosarcoma in the hard palate in a 25 year old male which was treated with radon seeds. He has remained clinically well for 3 years.

Three of the cases involved the tongue; all lesions were squamous cell epitheliomata showing pearls and occurred in 24 and 30 year old males and a 30 year old female. None of these patients used tobacco, in 1 case the teeth were in very bad condition and a second patient had been undergoing treatment for syphilis, all the Wassermann reactions were negative at the time of admission. The symptoms given were those of a "sore" on the tongue which had been present for 2 or 3 months in each case.

The growth in the 24 year old male was very far advanced with a large tumor mass in the submaxillary region which was fixed to the jaw bone. X ray treatments with 200 kilovolt X rays were given but the patient died without palliation in 5 months.

The lesion in the 30 year old male involved the left side of the tongue at the junction of the middle and posterior thirds and looked like an old leucic lesion undergoing malignant change. This was treated with radon seeds into the tongue and 200 kilovolt X rays to the neck. The patient was clinically well for 10 months when he committed suicide.

The lesion in the 30 year old female involved the left side of the tongue near the base. It was treated by the implantation of radon seeds and 200 kilovolt X rays the patient died in 3 months without improvement.

One case, an epithelioma of the tonsil and base of the tongue was treated by the implantation of radon seeds and the radium pack. Within 1 month radical surgery was done at another hospital. The patient died 8 months after admission from the disease.

Three cases occurred in the pharynx, 1 was a transitional cell epithelioma in a 14 year old male and involved the posterior pharyngeal wall, it was a hard fixed lesion 4 centimeters in diameter with palpable nodes in both sides of the neck.

This patient was treated with the 4 gram radium pack and has remained clinically well for 2 years.

The second case was a lymphosarcoma in the pharynx with a hard metastatic node in the peritonsillar region. It was treated by means of radon seeds implanted into the tumor and 200 kilovolt X rays to the neck. The patient died in 4 months.

The third case was a spindle cell sarcoma of low grade malignancy in a 27 year old colored male, which involved the pharynx, arising from the left side of the base of the tongue. This entire tumor mass was removed surgically but the patient was lost trace of 2 months later.

### NASAL CAVITY

There were 15 cases of malignancy which occurred in the nasopharynx, 5 epitheliomata, 4 lympho epitheliomata, and 6 sarcomata. Table VI shows the ages and sex of these patients.

The symptoms in the cases of epithelioma, lympho epithelioma, and lymphosarcoma had existed in most instances for from 2 to 6 months, in only 2 cases for more than 6 months. These symptoms were headaches, sore throats, or earaches, followed by shortness of breath, obstruction to breathing in one or both nostrils, and in most cases, swelling of the nodes in the neck either one or both sides. Two patients had bleeding from the nose, and 2, mucous discharge from the nose. Several complained of difficulty in swallow.



TABLE VI—AGE AND SEX—NASAL CAVITY MALIGNANCIES

[illegible]

The 3 cases of lymphosarcoma of the nasopharynx occurred in 22, 24 and 26 year old males

...and the quality

The 18 year old female was treated with 200 kilo volt X rays. She died in 2 days from an embolism, and autopsy showed metastases in the lungs.

The 20-year-old male was treated by the implantation of radon seeds further treatment had been planned, however, after this preliminary treatment and 5 months after admission

The 3 other cases were treated by radon seed implantation into the nasopharynx and external irradiation with  $^{60}\text{Co}$  X rays or radium needles in both sides of the neck. In one case the lesion in the nasopharynx completely disappeared, but 8 months after treatment a metastasis developed in the right lung. The patient died 3 months later of pneumonia and metastases in the liver, pelvis, and other organs. At the time of death the lesion in the nasopharynx remained well

The 2 other patients died in 6 months and 2 years 2 months, respectively, from progression of the disease

There were 4 cases of lympho-epithelioma occurring in 14 and 24 year old females and 17 to 21 year old males. All were treated externally, one by 200 kilovolt X-rays and the other 3 with the 4 gram radium pack. Those treated with the radium pack had supplemented treatment by means of radium tubes inserted through the nares. One patient died in 1 month, 1 has been clinically well for 1 year 3 months, and the other has had palliation for 1 year 5 months. The patient who was treated with X-rays only, died in 6 months.

## SALIVARY GLAND

It is remarkable to note that 53 per cent of the cases which involved the nasopharynx occurred in Italians

The alveolar type of carcinoma is the most common type of lung cancer. It is a malignant tumor that starts in the alveoli, the small air sacs in the lungs. It is characterized by the presence of malignant cells in the alveoli. The disease is often diagnosed when the tumor has grown large enough to be seen on a chest X-ray. The prognosis is generally poor, with a median survival time of about 12 months. Treatment options include surgery, chemotherapy, and radiation therapy. The disease is often fatal, but early detection and treatment can improve the chances of survival.

The 32 year old male was treated with 200 kilovolt X rays and the insertion of a radium tube through the mars but he died from sarcomatosis in 6 months. The third case, the 30 year old patient, was treated with 1 gram radium pack, following which there was complete disappearance of the lesion. Seven months later there was a recurrence which was treated with radium tubes inserted through the mars and 200 kilovolt X rays to the right neck. Now, 3

The 3 cases of lymphosarcoma of the nasopharynx occurred in 22, 24 and 26 year old males

In the 22 year old male the disease was far advanced. Treatment consisted of surgical removal of the tumor from the orbit and nose, and the patient died 10 months after admission of the disease.

The 24 year old male was treated with 200 kilovolt X rays and the insertion of a radium tube through the naris but he died from sarcomatosis in 9 months. The third case, the 26 year old patient, was treated with a 4 gram radium pack, following which there was complete disappearance of the lesion. Seven months later there was a recurrence which was treated with radium tubes inserted through the naris and 200 kilovolt X rays to the nape of the neck. Now, 3 months later the patient is well.

TABLE VII—AGE AND SEX IN SALIVARY GLAND MALIGNANCIES

	Age																		Sex	
	11	13	17	18	19	20	21	22	23	24	25	26	27	28	29	30	M	F		
Mixed salivary tumor	1	1	1	1	1	1	1	1		1	1	1				1	6	8		
Spindle cell sarcoma				1													1			
Lymphosarcoma																1				1

malignant tendencies in that they recur, extend, and even metastasize, causing death. This is shown in one of the cases reported here, the tumor occurred in a 26 year old male, recurred twice, and now shows metastases to the mediastinum and bones (fifth lumbar vertebra and tibia).

The symptoms in the cases of mixed tumor were gradual, painless swellings which had existed for from 3 weeks to 5 years before admission. Three patients noticed this swelling less than 6 months before seeking advice, 4 between 1 and 2 years, 3 between 2 and 3 years, 1 for 3 years, 1 for 4 years, and 2 for 5 years.

Eight of the 14 patients with mixed tumors had had surgical removal of the tumor before admission. One patient who had had no recurrence was not treated. Eight months after admission there was still no recurrence. In 4 of the patients there was a thickened scar at the time of admission, 3 of them were treated with 200 kilovolt X rays and 1 with the 4 gram radium pack. These 4 have been clinically well without recurrence, 1 for 5 years, 1 for 5 years 4 months, 1 for 4 years when she was lost trace of, and 1 for 11 months since the time of admission. In 3 patients the disease had recurred following surgery. These also were treated with 200 kilovolt X rays. One was lost trace of in 1 month. In 1 the tumor remained stationary for 8 years when it was again removed surgically and the patient has been free from the disease for the past 5 years. In the third case, the tumor was held in check for 2 years 7 months when it began to grow. In spite of irradiation it has continued to grow and has metastasized to the mediastinum and bones (fifth lumbar vertebra and tibia).

One patient who had had biopsy before admission was treated with 200 kilovolt X-

rays and died in 2 months. The disease was far advanced.

The 5 other cases of mixed tumor were treated in the following manner:

An 11 year old female had biopsy followed by 200 kilovolt X ray treatment and the tumor has remained stationary for 4 years 3 months.

An 18 year old female was treated by radon seeds implanted into the lesion. This was improving when she died 2 months after admission from a chorionic epithelioma.

A 20 year old female treated with 200 kilovolt X rays and removal of the tumor and radium inserted into the wound has been clinically well for 9 years.

A 26 year old female had biopsy and the tumor was treated with radium pack and only a thick scar has been present for 2 years.

The 30 year old male was treated with 200 kilovolt X rays and radon seeds. This lesion was on the hard palate, was very far advanced at the time of admission and the man died 3 months later.

The patient with the spindle cell sarcoma in the parotid gland gave a history of being struck by a stone  $4\frac{1}{2}$  years before admission, following which he noticed a swelling in the parotid region. The growth was removed surgically, treatment with 200 kilovolt X rays followed, and finally the lesion was coagulated. The tumor recurred after coagulation and caused death 6 months later.

The lymphosarcoma of the parotid in the 30 year old female had been removed 10 years before admission, recurred 2 years after removal, and grew gradually. This woman was treated with 200 kilovolt X rays and 4 years 8 months after admission died of a hemorrhage from the ulcerating lesion.

#### THYROID

There were 3 cases of malignancy of the thyroid (11), all the patients were females, aged 14, 24, and 30. Two of the tumors were carcinomata and 1 was an adenocarcinoma.

The 14 and 24 year old patients noticed a lump in the neck which grew gradually and caused coughing and choking spells. One had existed for 3 months and one for 4 months at the time of admission.

The 30 year old patient had had a goiter for 12 years which gradually became larger and for a few

TABLE VIII—AGE AND SEX IN RESPIRATORY TRACT MALIGNANCIES

Sex	Age	Epi- glottis	Larynx	Bronchus	Lung	Mediastinum	Pleura
F	21						
M	20						
	19						
	18						
	17						
	16						
	15						
	14						
	13						
	12						
	11						
	10						
	9						
	8						
	7						
	6						
	5						
	4						
	3						
	2						
	1						
	0						

months before admission she had had difficulty in swallowing and some pain

The 33 year old male was a switchman in a railroad yard. He gave a history of a chronic laryngitis of long standing due to irritation from soot. This patient was treated by laryngectomy followed by 200 kilovolt X rays. He has been clinically well for the past 6 years.

The 30 year old male complained of hoarseness for 15 months before admission followed by choking sensations. He was treated by tracheotomy and low-power filtered X ray and died in 6 months.

The 2 carcinomata of the bronchus occurred in 29 and 26 year old males. One was not treated, the other died 3 days after admission and autopsy showed carcinoma of the bronchus with metastases to the liver and both adrenals.

The 24 year old male with carcinoma of the lung was treated with the 4 gram radium pack but died 2 months after admission. Autopsy showed a large tumor in the lung, and in the mediastinal and bronchial nodes, and metastases in the cervical lymph nodes. This patient had what he thought was a cold, with shortness of breath, a feeling of pressure in his chest, and difficulty in swallowing, for 5 weeks before admission.

The 26 year old male with endothelioma of the pleura was admitted complaining of swelling of the nodes in the groin which were removed, the area was then irradiated. This man succumbed in 9 months from generalized metastases, and autopsy showed a primary endothelioma of the pleura.

The 21 year old female with endothelioma of the pleura was treated with 200 kilovolt X rays and died in 5½ months. Autopsy showed a primary tumor of the parietal pleura on the right side with multiple extensions to mediastinal, abdominal and retroperitoneal lymph nodes, to both kidneys, mesentery of intestines, and diaphragm.

The 22 year old male with endothelioma of the mediastinum had a biopsy of one of the cervical nodes, he was treated with radium packs but was lost trace in 1 month.

In the case of epithelioma intrinsic larynx in the 20 year old female, the patient complained of hoarseness for 2 years before admission. Treatment was

in the case of epithelioma intrinsic larynx in the 20 year old female, the patient complained of hoarseness for 2 years before admission. Treatment was

TABLE IX.—AGE AND SEX IN GASTRO-INTESTINAL TRACT MALIGNANCIES

	Age												Sex	
	19	20	21	22	23	24	25	26	27	28	29	30	M	F
Stomach								1				1	1	1
Sigmoid			2								1		2	1
Rectum and anal canal	1	1			1	1	3	1	1	1	3	6	1	9

The carcinoma of the mediastinum occurred in a 21 year old male

This patient died the day following admission and autopsy showed a tumor of the mediastinum, weighing 1,900 grams the histology of which was carcinoma. The primary site was thought to be aberrant thyroid

The 4 mediastinal tumors, not proved histologically occurred in patients 13 22 28, and 29 years of age respectively. Three were males, 1 female

The 13 year old male and the 28 year old female were not treated

The 22 year old male had radium pack treatment but he died in 1 month with no improvement

The 29 year old male was treated with 200 kilovolt X rays following which his symptoms improved. The tumor remained stationary 4 years 3 months after admission

#### GASTRO INTESTINAL TRACT

There were 24 cases of malignancy of the gastro intestinal tract. 2 carcinomata of the stomach, 3 adenocarcinomata of the sigmoid, 18 carcinomata of the rectum and 1 epithelioma of the anal canal. Table IX shows the ages and sex

Both cases of carcinoma of the stomach were inoperable were treated with 200 kilovolt X rays and died in 4 months and 5 months respectively. Both of these patients complained of gastric distress which was chiefly the uncomfortable feeling of gas 1 for 4 months and 1 for 1 year before admission. Ewing says of carcinoma of the stomach "While the disease is distinctly one of advanced age, its rather frequent occurrence between 20 and 40 years, and even between 20 and 30, is noteworthy." Fowler reported 9 cases of carcinoma of the stomach before the age of 26 years

Two of the patients suffering from adeno-

carcinoma of the sigmoid were operated upon and then irradiated, the other was irradiated only. This latter patient died 2 weeks after admission and autopsy confirmed the diagnosis. The 29 year old female who had a positive Wassermann reaction, died in 8 months, but the 21 year old male is living and well for almost 2 years since admission

Fowler (2), in reviewing carcinoma of the large bowel and rectum occurring in patients below the age of 26 calls attention to the seriousness of these lesions. No rectal case in his series survived one year. Cripps, quoted by Ewing, found only 3 cases of carcinoma of the rectum between 20 and 30 years in a review of 380 rectal cancers. In our series there were 18 out of 634 cases

Biopsies from 15 cases of carcinoma of the rectum showed gelatinous carcinoma in 3 cases, adenocarcinoma in 10, and carcinoma in 2. Three very far advanced cases had no biopsy. Biopsy from the lesion in the anal canal showed squamous cell epithelioma with pearl formation

Three of these patients had been operated upon for hemorrhoids before admission but the primary lesion was not discovered, 2 had had colostomies performed. The chief complaints were pain, bloody and mucous discharge, constipation and diarrhoea. The duration of these symptoms varied from 2 months to 2 years, most patients had symptoms for less than 8 months

All the rectal lesions were far advanced at the time of admission. Three were not treated. The others were treated by radiation, usually radon seeds implanted into the growth and supplemented externally with either radium packs or 200 kilovolt X rays. In a few cases external irradiation only was given. Eight patients died in less than 6 months, 2 in from 6 months to a year, 4 in from 1 to 1½ years,



TABLE XI.—CARCINOMA BREAST  
*Postoperative Recurrent Cases (11 cases)*

Age	Marital status	Lactation	Duration before admission	Length of time since operation	Duration of recurrence	Section	Result
26	S		4 yrs. 6 mo	4 yrs.	2 yrs.		Died 6 yrs. 9 mo. from admission (good palliation from irradiation)
26	M	2 normal pregnancies	1 yr.	4 mos.	1 mo.	Carcinoma	Died 1 yr. 3 mo.
26	M	2 normal pregnancies 1 miscarriage		2 mos.	6 wks.	Carcinoma	Died 11 mos.
26	M	1 normal pregnancy	1 yr. 10 mo.	1 yr. 7 mo.	1 mos.	Carcinoma	Died 6 mos.
28	S		5 yrs.	13 mos.	10 mos.	Colloid Carcinoma	Clinically well 1 year—recurrence after admission Died 4 yrs. 9 mo.
29	S		3 yrs. 4 mo.	3 yrs.	2 yrs.	Scirrhous carcinoma	Died 2 mos.
29	S		2 yrs.	1 yr. 11 mo.	few mos.	Carcinoma	Died 3 mos.
30	M	1 normal pregnancy	5 mos.	1 mo.			Died 8 mos.
30	M	4 normal pregnancies	3 mos.				Not treated
30	M	5 normal pregnancies	1 yr.	5 mos.			Died 4 mos.
30	M		1 yr. 6 mo.	1 yr. 6 mo.	3 mos.		Died 1 yr. 1 mo.

NOTE.—All deaths were due to widespread metastases  
Injury

in reviewing the 10 year survivals of mastectomy says "The younger patients contrary to common belief, do quite as well following operation as the average patients."

According to Deaver and McFarland, 13 per cent of all tumors of the breast before the age of 30 are cancer. They quote Rodman as saying that 9 per cent of all tumors of the breast before the age of 30 are malignant, and also speak of the poor prognosis of cancer of the breast in women under the age of 35.

It has been our experience that malignancy of the breast in young women is more virulent, especially if complicated with pregnancy or lactation.

Table X shows the ages, marital status, lactation, history of injury, treatment, section, and results of treatment of our 25 cases. The Group I cases are those in which the tumor was confined to the breast, Group II, with metastases in the axilla, or ulceration of the skin, Group III, tumor in the breast which is fixed to the chest wall or ulcerating, with widespread metastases. All the postoperative, recurrent cases in Group III, had widespread metastases at the time of admission.

#### FEMALE GENERATIVE ORGANS

The gynecological malignancies have been reported in detail by the authors (13).

There were 115 patients 30 years of age or younger suffering from malignancy of the female generative organs: 78 epitheliomata of the cervix, 1 adenocarcinoma of the cervical canal, 1 adenocarcinoma and epithelioma of the cervical canal, 23 malignant tumors of the ovary, 1 adenocarcinoma of the fundus of the uterus, 2 malignant leiomyomata of the uterus, 2 chorionic epitheliomata of the uterus, 3 epitheliomata of the vagina, 1 botryoid sarcoma of the vagina, 3 epitheliomata of the vulva.

Table XII shows the ages and marital status of the patients in this group.

If seen early there is a good possibility of eradicating epithelioma of the cervix. The recognition of the disease in its early stage, especially in young women, is important, as it may be the means of saving the life of a young mother so needed for her children's sake. It will be found that cancer prevention in this particular group lies within the grasp of the family physician, who should acquaint himself with evidences of cervicitis, ulcerations, erosions, and leucoplakic areas on the cervix so that he may advise proper treatment for these precursors of malignancy. Abnormal discharges in young women are indications of pathological conditions. Blood as a symptom must be looked upon as accidental—yellow.

TABLE XII--FEMALE GENERATIVE ORGAN MALIGNANCIES

Age	Marital status										Epithelioma cervix	Adenocarcinoma cervical canal	Adenocarcinoma and epithelioma cervical canal	Malignant tumors ovary	Malignant fundus uterus	Malignant leiomyoma uterus	Chronic epithelioma uterus	Epithelioma vagina	Bartholin's cyst, vagina	Epithelioma vulva
	2	11	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	5	21
21																				
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ish, watery, or foul-smelling discharge usually precedes the showing of blood, which does not occur until the tumor begins to ulcerate and break down. Our only hope of discovering and treating early lesions of the cervix lies in careful gynecological examination to biopsy and cauterization in the so called cervix and erosion to rule out or discover cervical malignancy.

Cervical cancer in young women here reported in Groups I and II (Schmitz) have yielded healings in about the same proportion as the average in cancer of the cervix, namely, 50 and 33 per cent. Groups III and IV have been only palliative. All treatment has been by 200 kilovolt X-rays externally and radon seeds and radium intra-uterine. Only 1 patient in this group under 30, suffering from epithelioma of the cervix, was unmarried. The 17 others had from 1 to 8 pregnancies, bearing out the theory that trauma and inflammatory lesions have a great influence in the production of malignancy of the cervix.

The only hope in the treatment of ovarian malignancy lies in the early recognition of the disease, and its early treatment by operation and irradiation. The 23 malignant tumors of the ovary include 6 papillary cyst adenocarcinoma, 6 adenocarcinoma, 9 carcinosarcoma, and 1 malignant teratoma. Thirteen of these patients were single, and 10 were married.

Of the 23 cases, only 2 were not proved pathologically, 1 had no operation and the other had had a laparotomy but no section was taken. The majority of these patients had been operated upon before admission. One patient was not treated, the others received either 200 kilovolt X-rays or 4 gram radium pack treatment. Six of the patients have lived from 5 months to 8 years after treatment and have been free from the disease for 5 months, 6 months, 2 years 2 months, 2 years 8 months, 2 years 10 months, and 4 years, respectively. This latter patient is alive 8 years since the time of admission but suffered a recurrence 4 years 4 months after original treatment and then was operated on and treated again. Three others are living but are not free from the disease, 2 for over a year with some palliation, and 1 for 2 months unimproved. Three were lost trace of and the 10 others died, 7 in less than a year, 2 in 1 to 2 years, and 1 in 5 years 11 months.

The case of adenocarcinoma of the uterus in a 30 year old patient, was treated with intra-uterine radium application and 200 kilovolt X-rays over the pelvis. The patient was lost trace of 1 month after treatment.

There were 2 cases of malignant leiomyomata.

One occurred in a patient aged 24, married, whose menstrual periods from the age of 14 were regular but rather profuse, lasting from 7 to 8 days. She had had one miscarriage but no other pregnancies. Seven weeks before admission menstrual periods

TABLE VIII—AGE AND SEX—KIDNEY MALIGNANCIES

	Age							Sex	
	10 yrs.	1 yr.	2 yrs.	3 yrs.	4 yrs.	12 yrs.	15 yrs.	M	F
Adenocarcinoma	1	1	1					2	1
Mixed tumor			1	1	1	1		2	1
Embryonal adenocarcinoma							1		1

became longer and harder. Hysterectomy was performed for a supposed fibroid uterus. Pathological examination showed this tumor to be a malignant leiomyoma. This patient received 50-kilovolt X-ray treatments 1 month following operation and was alive without recurrence 4 years and 7 months after treatment when last examined.

The other case occurred in a patient aged 24 years married with 6 children.

This woman had given birth to a child 6 months previous to admission following which she had a 9 day hemorrhage. Four months after the birth of the child a hysterectomy was performed for a malignant leiomyoma. At the time of admission there was a recurrence in the vault of the vagina extending into the broad ligament areas. She was treated by radium applications but the lesions progressed and she died without any palliation 9 months later. Autopsy showed recurrence in the pelvis and generalized metastases.

One case of chorionic epithelioma was observed in a patient aged 30 years married a mother of two children ages 8 and 5 years.

Her menstrual periods from the age of 12 were always irregular. At the age of 19 she began to have a yellowish discharge and for 3 months previous to admission she had continual bleeding following a miscarriage. A pan hysterectomy was performed and sections from the body of the uterus showed the presence of a chorionic epithelioma. Post-operative irradiation was given and this patient is alive and well 14 years after admission.

The second case of chorionic epithelioma occurring in an 18 year old female was found at autopsy.

This patient had been treated at the institute for a salivary tumor inner right cheek, was single and gave no history of menstrual disturbance or pregnancy. She was operated on for a ruptured ovarian cyst 2 months before admission.

Three cases of epithelioma of the vagina were observed, 2 in patients aged 30 and one in a patient aged 28.

One patient, aged 30 gave a history of bearing down pain for 7 months, last menstrual period 3 months previous to admission. She was 3 months pregnant at the time her family physician excised a growth section of which showed it to be an epithelioma. There was a recurrence of this lesion within a month. Upon admission, the recurring tumor was implanted with gold seeds of radon following which there was a prompt regression of the tumor. The pregnancy proceeded uninterrupted to full term when a healthy child was born. On last examination, there was no evidence of recurrence 14 months after treatment.

This case typifies the necessity of prompt and accurate treatment, which in this case was successfully performed and was not only the means of saving the life of a mother up to the present time but also the life of a child conceived before radiation treatment.

One was in a syphilitic, aged 28 who gave a history of continuous bloody discharge only over a period of 3 months. The lesion was far advanced and involved the anterior and lateral walls of the vagina. She was treated by irradiation, which proved of little benefit, and she succumbed to the disease 9 months after admission.

The other also was a far advanced case.

This patient's periods were irregular occurring every 2 weeks and she complained of a yellowish discharge between her supposed menstrual periods. At the time of examination there was a large infiltrating growth involving the posterior wall of the vagina and extending into the posterior fornix. She was treated by irradiation but succumbed to the disease in 2 months.

The botryoid sarcoma of the vagina occurred in a child 2 years of age.

About six months prior to admission the mother had noticed a swelling in the lower abdomen but the child complained of no pain. Following this a growth was found protruding from the vagina and involving the vulva. Part of the growth was removed by her family physician. At the time of examination at the institute there was a tumor mass in the lower abdomen extending to the umbilicus and a purulent dis-



Here, included in this history, is evidence of neglect on the part of the physician to render prompt and efficient treatment

The other patient, aged 30 years, was single, the lesion had recurred after operation and was far advanced at the time of admission. It was ulcerated and involved the whole vulva. The treatment was irradiation for palliative effect but she died in 6 months

#### GENITO-URINARY TRACT

There were 36 malignancies of the genito-urinary tract in patients under 30 years of age. Three adenocarcinoma, 4 mixed tumors and 1 embryonal adenocarcinoma of the kidney, 1 congenital sarcoma of the adrenal, 3 epithelioma of the penis, 24 malignant teratomata of the testicle

The kidney tumors were all treated with external irradiation, either radium packs or 200 kilovolt X-rays. Four of these cases had had removal of the kidney before admission and 1 an exploratory operation in which the tumor was too far advanced for removal. All patients except the one suffering from the embryonal adenocarcinoma died in less than 2 months from the time of admission. This patient lived for 1 year 2 months but succumbed from progression of the disease at that time

Table XIII shows the ages and sex of the patients with kidney malignancies, under the age of 30

The congenital sarcoma of the adrenal occurred in a 2½ year old male and was treated with 200 kilovolt X-rays. He died in 2 months and autopsy showed metastases to the liver and lungs

Malignant tumors of the testicle represent about 0.03 per cent of the total number of malignancies admitted to the institution. Twenty-four of these occurred at the age of 30 or younger, or 43 per cent of the total number of testicular tumors. All of these cases were regarded as malignant teratomata, which were divided as follows: 4 adult type, 12 solid embryonal teratomata, 1 embryonal teratomoma with lymphoid stroma, 6 embryonal adenocarcinoma, and 1 unclassified (no section)

Table XIX shows the ages at which the testicular tumors of different types occurred

charge from the vagina. There was a fungating tumor mass involving the vagina and vulva. Sections from this growth showed it to be myxoblastosarcoma, or sarcoma botryoid. The child died of the disease 4 months after irradiation was administered and 10 months from the beginning of symptoms

Ewing says "Rhabdomyoma uteri appears almost exclusively as an element in the poly-poid vaginal sarcoma of children and adults (sarcoma, botryoid, Pfannenstiel). This process affects the vagina in children and chiefly the cervix in adults (Gow and Pick). The symptoms are hæmorrhage, fetid discharge, and a protrusion of a polypoid tumor from the vagina, with dysuria, pain, fever, and cachexia. The vagina is eventually filled with ulcerating masses and there are bulky extensions into the pelvis. The usual histology is that of a large spindle-cell sarcoma, with tendencïes and areas of striated muscle." Three cases of epithelioma of the vulva were observed, one in a patient aged 25, and 2 in patients aged 30

The patient aged 25 was single and gave a history of having a small nodule which occurred in the clitoris 1 year prior to admission. At the time of examination there was an exceedingly painful, ulcerating tumor about 3 centimeters in diameter which involved the region of the clitoris and there were palpable inguinal and femoral nodes. The lesion was treated by irradiation with temporary improvement. During the course of one year the disease progressed and she finally succumbed to extensive involvement of the whole vulva and inguinal lymph nodes

In this particular case the use of strong doses of bichloride of mercury may have been an etiologic factor

One of the patients, aged 30, was married. Ten months before admission she noticed a small sore on the labia. She consulted a physician who told her it was an ingrown hair and removed it. As she did not get any relief, she consulted another physician months' pregnant, she went to still another physician but with no better results. Later, as she was 5 months' pregnant, she would probably improve after who told her the sore would probably improve after childbirth. At the time of admission to the institution the baby was 8 weeks old and the soreness had increased. Examination showed an ulcerating, inflating epithelioma involving the whole vulva and perineum. Irradiation in this case was of little or no avail and she died in 4 months

TABLE XIV—AGE INCIDENCE—TUMORS OF TESTIS

Age	10 mo	17 yrs	20	21	22	23	24	25	26	27	28	29	30
Adult type	1		1								1	1	
Solid embryonal carcinoma (seminoma)		1	2			2				3	1	1	1
Embryonal carcinoma with lymphoid stroma									1				
Embryonal adenocarcinoma							1	1	1			1	1
No section				1									

One adult type teratoma occurred in a child 10 months of age. It was treated surgically, the testicle being removed followed by treatment with 200 kilovolt X rays over the lymph bearing areas in the groin and abdomen. This patient is alive and well 9 years after treatment.

The 3 others in this group had widespread metastases at the time of admission and were treated surgically by removal of the testicle and cord followed by 200 kilovolt X rays. Two died in 2 months each, and the other has been having palliation for 6 months.

Eleven of the 12 cases of solid embryonal carcinoma (seminoma) had widespread metastases at the time of admission. Six of them had metastases to the lungs as well as retroperitoneal nodes. All were treated by removal of the primary tumor and radiation radium packs in 5 cases, and 200 kilovolt X-rays in 7 cases. One patient survived 4 years 9 months after which he succumbed to the disease. The others all have died: 1 in 2 years (this is the one without metastases at the time of admission), 1 in 1 year 1 month, 1 in 1 year, 8 in less than a year.

The patient with the embryonal carcinoma with lymphoid stroma had metastases in the abdominal nodes and liver at the time of admission. He was treated by removal of the testicle and 200 kilovolt X rays and is alive and well 1 year 4 months after admission.

The 6 patients with embryonal adenocarcinoma were treated by removal of the testicle followed by 200 kilovolt X rays in 5 cases and radium packs in 1 case. Only one patient was free from metastases at the time of admission. He is alive and well 4 years since admission. All the others had widespread metastases, 4 having metastases into the lungs and mediastinum. These died: 1 in 1 year 5 months, 4 in 2 to 4 months.

The symptoms given in the histories were pain in 3 cases, swelling in 10 cases, swelling and pain in 5 cases, swelling and pain following injury in 6 cases. The duration of these symptoms was from 2 weeks to 6 years. The majority of patients had symptoms for less

than a year. 11 gave a history of duration for less than 6 months, 9 for less than a year. From the authors' point of view, it is very difficult to evaluate the history of trauma as an etiological factor.

Most authorities are agreed on the statistical fact that malignant tumors of the testicle are very virulent. Stout says, "In general it may be said that testicular cancers are prone to be exceedingly malignant and fatal." Hinman collected 100 cases treated by radical operations, 17 per cent of which are alive at the end of 5 years.

The analysis of testicular tumors in this paper has to do only with those tumors which occurred in patients 30 years of age or younger. In all the testicular tumors admitted to the state institute, the ages ranged from 10 months to 49 years. The disease occurring in patients 30 years of age or younger seems to be more virulent than after the age of 30.

Herger and Thibaudeau, in studying all the cases of malignant teratoma of the testes admitted to the institute, 55 proved cases, find 36 cases available for 3 year statistics, of which 13 or 36 per cent have survived 3 years or longer, 21 cases available for 5 year statistics of which 7 or 33.3 per cent, have survived 5 years or longer. They conclude that the embryonal carcinoma with lymphoid structure seems to have the better prognosis.

Epitheliomata of the penis occurred in 20, 28, and 29 year old patients. Two of these lesions were of the papillary type.

The 20 year old patient had a positive Wassermann reaction and gave a history of having noticed a pimple on the glans which gradually grew larger. Upon admission to the institute he was treated by radical operation and low power X ray. He was clinically well for 7 years and then was lost trace of.

The 29 year old patient had an operation 19 months before admission for phimosis. The incision healed with a warty growth which became ulcerated.

the ilium in 1 patient, the supra-orbital ridge in 1 patient, and the lower jaw in 4 patients. All of these tumors were far advanced on admission, 6 patients having metastases in the lungs in addition.

In 6 cases the extremity was amputated and treated by irradiation, either 200 kilovolt X-rays or radium packs. Four of these patients died in 9 months, 1 in 1 year, 1 in 2 years, from metastases to the lungs, no recurrence on the stump.

One patient was lost trace of in 1 year 6 months at which time he wrote he was feeling well, the other died 11 months after amputation from pulmonary tuberculosis, no recurrence of the malignancy at the time of death.

In one case the tumor was removed from the right tibia followed by irradiation and this patient is now clinically well 1 year 6 months since admission.

Sixteen other cases in which the tumor involved the extremity were treated by irradiation only. Thirteen died in less than a year, and 3 died in from 1 to 2 years.

In 1 case the tumor in the os calcis was removed surgically and then treated by radiation. The growth was arrested for 4 years when a bluish-looking tumor developed in the scar over the same foot where it was irritated by the patient's shoe. This grew with a sudden rapidity necessitating amputation of the leg. Patient was months pregnant at the time of amputation and a normal child was born 5 months before her death from general metastases to the lungs and viscera 8 years 5 months after admission.

The sclerosing osteogenic sarcoma of the humerus which was treated by irradiation only, has been arrested for 3 years.

One of the perithelioma occurred in the fibula, the leg was amputated elsewhere. The patient died 2 weeks after amputation.

The perithelioma in the femur was treated with 200 kilovolt X-rays and the patient died 9 months after admission from progression of the lesion and metastases to the lungs.

The tumor in the axilla was removed surgically and histologically showed osteogenic sarcoma. The patient was then subjected to irradiation and has been clinically well for 2 years 4 months. This was a case of osteosarcoma in soft tissue but with no involvement of bone.

The osteogenic sarcoma of the ischium had metastasized to the lungs and pelvis at the time of admission. This was treated with irradiation but the patient died in 1 month.

The tumor in the ilium also was treated by irradiation and is now progressing, 8 months after admission.

The sarcoma in the supra-orbital ridge was incised when the

He was treated by amputation of the penis and low power X-ray and has been clinically well for 12 years 8 months.

There was 1 case of carcinoma in the sacral region in a 30 year old female. Although biopsy showed carcinoma, we believe this may have been a malignant teratoma. Four months before admission this patient noticed severe pain and swelling of the hip. She was treated with the radium pack and died 5 months after admission from progression of the disease.

Another case, in a 30 year old male, was an adenocarcinoma of the left scapula. The growth had been removed at the time of admission, he was treated with 200 kilovolt X-rays, did not improve, and was lost trace of in 3 months.

Another was a metastatic carcinoma of the neck in a 29 year old male. The primary source was not ascertained. He was treated with 200 kilovolt X-rays and died in 3 months.

There were 6 cases of endothelioma 3 in the lymph nodes in the neck, 2 in the thigh with metastases in the groin, and 1 in the soft tissues over the hip, in 7, 12, 14, 21, and 29 year old patients, 2 males, 4 females. All had histological sections, were treated with 200 kilovolt X-rays and died in from 5 to 9 months from the time of admission from generalized metastases.

There were 48 primary bone sarcomata in patients under 30 years of age, 36 osteogenic sarcomata (including 1 sclerosing type, 2 perithelioma, 1 myxoblastoma), 3 osteochondrosarcoma, 3 chondrosarcoma, 1 hereditary deforming chondrodysplasia with secondary chondrosarcoma of the femur, 5 Ewing sarcomata.

The 36 osteogenic sarcomata involved the upper extremities in 9 patients (8 humerus, 1 forearm), the axilla in 1 patient, the lower extremities in 19 patients (12 femur, 4 tibia, 1 fibula and 2 foot), the ischium in 1 patient, and 1 sarcoma in the supra-orbital ridge was incised when the

## MISCELLANEOUS

TABLE XV—AGE AND SEX INCIDENCE IN BONE MALIGNANCIES

	Age																								Sex		
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	M	F	
Osteogenic sarcoma	1	1	2	1				1	1			1	1	2	2	1	4	1		3	1	4	2	1	1	1	9
Sclerosing osteogenic sarcoma																				1					1		
Myxofibrosarcoma																				1					1		
Penthetoma								1												1					1	1	
Osteochondrosarcoma																1		1						1		1	2
Chondrosarcoma													1									1			1	1	
Hereditary deforming chondroplasia with secondary chondrosarcoma																1									1		
Ewing sarcoma					1			1	1	1	1	1				1									1	2	

treated by irradiation but the tumor progressed and the patient died in 1 year 11 months.

Two of the jaw tumors were treated by irradiation only 1 patient died in 3 months and 1 in 5 months. One patient is living for 6 years with arrest of the tumor following biopsy and irradiation. One tumor was excised and the patient then subjected to irradiation. This patient died in 7 months.

The symptoms in these cases were pain and swelling. Twenty-two patients gave a history of injury as the beginning of their illness. 8 fell striking the diseased part. 7 gave a history of muscle strain. 6 a blow, and 1 of being burned by the explosion of fire works.

One of the osteochondrosarcomata occurred in the humerus. This was treated by irradiation. The tumor process had apparently been arrested but was still present at the time of death from other causes 5 years 8 months after admission.

The second osteochondrosarcoma occurred in the femur. This was treated by irradiation and the patient died in 3 months.

The third tumor occurred in the sacrum. The tumor was removed and then the patient was irradiated, and died in 9 months. There was a history of injury in 1 case.

The three chondrosarcomata occurred in the sacroiliac region, sixth rib and the tibia. All were treated with 200 kilovolt X rays and died in 3 months, 5 months and 8 months respectively. There was a history of injury in 2 cases.

The hereditary deforming chondroplasia with the secondary chondrosarcoma of the femur occurred in an 18 year old boy. This was treated by irradiation and amputation of the femur was advised but refused. The lesion is rapidly progressing now, 1 year 8 months after admission.

The five Ewing sarcomata occurred in 7, 11, 12, 14 and 15 year old children, 3 in the tibia, 1 in the femur, and 1 in the ischium. Four

of them had a history of injury at the site of the tumor.

One patient with a tumor in the tibia had the tumor removed by curettage and was then treated with 200 kilovolt X rays. This child was clinically well for 2 years 11 months when there was a recurrence and she died 3 years 4 months after admission from generalized metastases.

Another patient with a lesion in the tibia was treated with irradiation and then the leg was amputated. He lived 2 years 2 months when he died from lung metastases.

The third patient with the tumor involving the tibia died in 2 months. He also was treated with 200 kilovolt X rays.

The patient with the tumor in the femur died 7 months after admission. There was some local improvement following X ray treatment.

The fifth case with the tumor in the ischium, is still alive 1 year 7 months after admission and has shown some local improvement following 200 kilovolt X ray treatment.

#### MISCELLANEOUS SARCOMATA

There were 72 cases of miscellaneous sarcomata not included in any of the foregoing groups of cases reported in this paper. Twenty-six were lymphosarcomata, 4 wherein the biopsy showed lymphosarcoma but the blood pictures were that of aleucemic leucemia, 4 angiosarcomata, 2 mixed cell sarcomata, 6 fibrosarcomata, 3 myxofibrosarcomata, 1 spindle cell sarcoma, 8 neurofibrosarcomata, and 4 unclassified sarcomata, as follows:

There were 26 cases of lymphosarcoma in patients under 30 years of age, 18 males and 8 females.

Nearly all of these patients gave the history of a painless swelling, only 2 gave the history

of any pain as the beginning of their illness. In 17 cases, the duration was less than 6 months; in 7 cases for 1 year each, and 2 cases for 3 years each. All of these growths developed rapidly. Twelve were noticed first in the neck, 1 in the paravertebral region, 2 over the scapula, 1 in the axilla, 1 in the forearm, 4 in the abdominal nodes, and 5 were lymphomas—comatose, primary source unknown. With one exception—a leucocyte count of 26,600—one original leucocyte counts varied from 7,000 to 13,900. In only 4 instances did the percentage of lymphocytes exceed 30.

(One case in this group was not treated. The remaining hereditary cases were unable to report for observation or treatment. The lesion progressed and the leg was amputated at another hospital. Five months later there are numerous and widespread metastases and patient is moribund.

Three of these patients gave a history of injury as the beginning of their illness. There were 2 cases of mixed cell sarcoma, 1 on the foot of a 24 year old male and one in the thigh of a 30 year old female.

The lesion in the 27 year old male had existed 5 years previous to admission, appearing as a swelling which followed an injury caused by a well-sharpened

There were 4 cases in which the biopsy showed lymphosarcoma but the blood pictures in all assumed that of an aleucemic leucemia, the lymphocytes varying from 52 to 76 per cent 10 months before the metastases developed and the after admission nothing metastases developed and the

The disease occurred in a 23 year old female who died at 2 weeks following 200 kilovolt X rays, a 12 year old male who also died 2 weeks after admission, and a 1 year old male who is living 2 years after admission. This remained stationary for 2 years after which it began to grow rapidly. The growth had been removed about 3 weeks before admission. Upon admission, the incision was neatly healed and she was treated prophylactically with 200 kilovolt X rays. There has been no recurrence up to the present time, 7 years 5 months after admission.

One occurred on the cheek of a 5 year old female This was removed surgically and treated prophylactically with a large amount of radon, highly filtered, and the patient has remained clinically well for 11 years

The next case of angiosarcoma occurred in an 11 year old female This child's trouble began with abscesses on the vulva following an injury in the gymnasium after which a mass developed in the pelvis Upon admission she had a generalized sarcomatous She was treated with 200 kilovolt X rays

There were 6 cases of *fibrosarcoma* These lesions occurred 1 on the top of the head, 1 over the eyebrow, 1 at the angle of the jaw, involving the bone, 1 over the shoulder, 1 in the thigh, and 1 in the abdominal wall Two of these patients gave a history of injury at the beginning of their present illness In all the cases the tumors were removed and treated with 200 kilovolt X-rays Three of

There were 6 cases of *fibrosarcoma*. These lesions occurred 1 on the top of the head, 1 over the eyebrow, 1 at the angle of the jaw, involving the bone, 1 over the shoulder, 1 in the thigh, and 1 in the abdominal wall. Two of these patients gave a history of injury at the beginning of their present illness. In all the cases the tumors were removed and treated with 200 kilovolt X-rays. Three of

Three of these patients gave a history of injury as the beginning of their illness. There were 2 cases of mixed cell sarcoma, 1 on the foot of a 24 year old male and one in the thigh of a 30 year old female.

The lesion in the 24 year old male had existed 5 years previous to admission, appearing as a swelling which followed an injury caused by dropping a sharp plank on his foot. This swelling grew gradually until 9 months before admission to the institution, after which it grew rapidly. It was excised 1 week before admission. The scar was treated with low power filtered X ray and appeared clinically well for 1 year after admission. Three years later a recurrence developed and the patient died. The lesion on the foot was not healed at the time of death.

The lesion in the 30 year old female began as a hard lump on the thigh  $2\frac{1}{2}$  years before admission. This remained stationary for 2 years after which it began to grow rapidly. The growth had been removed about 3 weeks before admission. Upon admission, the incision was nearly healed and was treated prophylactically with 200 kilovolt X rays. There has been no recurrence up to the present time, 5 years 5 months after admission.

There were 6 cases of *fibrosarcoma*. These lesions occurred 1 on the top of the head, 1 over the eyebrow, 1 at the angle of the jaw, 1 involving the bone, 1 over the shoulder, 1 in the thigh, and 1 in the abdominal wall. Two of these patients gave a history of injury at the beginning of their present illness. In all the cases the tumors were removed and treated with 200 kilovolt X-rays. Three of

TABLE XVI—AGE AND SEX INCIDENCE—SARCOMA EXCLUSIVE OF BONE SARCOMA

	Age																														Sex	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	M	F
Lymphosarcoma		1				1			1	1		2	1		2	2	1	1		1		1	3	1	1	1	1	1	1	1	18	3
Lymphosarcoma with aleucemic blood picture												1	1										2								3	1
Angiosarcoma						1						1									1			1							1	3
Mixed cell																							1						1	1	1	
Fibrosarcoma													1		1									1	2	1				1	2	4
Myxofibrosarcoma	1						1													1												5
Spindle cell		2									1	1					1	1						2	3	1	1	1	1	1	10	5
Neurofibrosarcoma												1					1			1	1			1	1	1	1	1	1	1	4	4
Unclassified	1														1							1									3	

the patients are clinically well since treatment, 1 for 5 years 1 for 1 year, and 1 for 7 months

In 1 case the tumor has remained stationary since the time of admission 1 year 2 months. The patient with the skull lesion died in 3½ months and autopsy showed fibrosarcoma involving the dura mater.

The patient in which the jaw bone was involved died 1 year 3 months after admission from progression of the disease.

There were 4 cases of *myxofibrosarcoma*. Two of these patients gave a history of injury as the beginning of their trouble.

One of these lesions occurred in the ischio-rectal space of a 17 months old female. The tumor was removed and treated with radium. She has been clinically well for 3 years without recurrence. One occurred over the sacrum of a 6 year old female was removed surgically and treated with 200 kilovolt X rays and has been clinically well for 4 months following last treatment. It is now 7 months since admission.

The third occurred in a 20 year old female at the knee. This was treated with the radium packs with no improvement. The leg was amputated elsewhere and the patient died 8 months after admission to our hospital from metastases into the chest.

The fourth case was in the arm of a 29 year old female. This patient also had a carcinoma of the left breast which is reported in this paper with the breast lesions. The breast lesion was treated at our institution but at the time of admission the arm had been amputated by shoulder girdle amputation. Sections of the lesion showed no bone formation. There has been no recurrence of the sarcoma for 10 years.

There were 15 cases of *spindle cell sarcoma*, 1 of the jaw, 1 mastoid region, 1 frontal region,

3 arm, 2 axilla, 2 shoulder, 4 lumbar region and 1 foot. Five patients gave a history of injury as the beginning of their present illness. One patient was not treated. The others were treated by the removal of the tumor followed by irradiation, either 200 kilovolt X rays or radium packs. Eight of the patients died from the disease 6 in less than a year, 1 in 12 years and 1 in over 6 years.

The patient who died 12 years after admission was clinically well for 9 years when there was a recurrence which responded to further treatment and the local lesion was well at the time of death from liver and lung metastases.

The patient who died 6 years 2 months after admission died from metastases to the lungs and axilla the lesion in the arm did not recur and had been clinically well for 4 years 4 months before death from metastases. Five of the patients are clinically well 2 for 14 years 2 for 2 years and 1 for 1 year. The other patient has been having palliation since admission, 8 months ago.

There were 8 cases of *neurofibrosarcoma*. Three of the patients gave a history of injury at the site of the lesion, previous to noticing the lesion. In 7 of the cases, the tumor was removed and irradiation treatment, either 200 kilovolt X rays or radium pack, was given.

In 1 case irradiation only was given by means of 200 kilovolt X rays. This patient died 10 months after admission from rapid extension of the lesion throughout the abdomen.

The others have been clinically well 1 for 10 years 1 for 3 years 2 for over 2 years, 2 for over 1 year, and 1 has been receiving treatment over a period of 4 years. There is no progression of the disease in this latter case but nodules are still present.

TABLE XVII—HODGKIN'S DISEASE

Cases	Ages	Cases
3	18	3
3	19	0
3	20	1
1	21	2
2	22	1
8	23	0
6	24	0
4	25	0
6	26	2
4	27	1
3	28	1
5	29	0
4	30	2
3		

was rarely observed. An intense pruritis is frequently associated with Hodgkin's disease, early as well as late. Fever may be present early but is usually associated with the terminal stages.

From the diagnostic point of view, the enlargement of the cervical chain, axillae, or inguinal nodes, which are painless, hard, and often associated with considerable fibrosis, are common clinical findings. Biopsy is essential in the diagnosis of Hodgkin's disease.

Irradiation in Hodgkin's disease is of distinct palliative value and is in all probability the best form of therapy today. The prognosis is always grave. The majority of patients suffering from this disease succumb before the end of 3 years.

Of the 64 cases of Hodgkin's disease in patients under 30 years of age 5 were not treated, the 59 others were treated with 200 kilovolt X-rays, with the following results: Forty-eight patients died, 21 in less than a year, 14 in 1 to 2 years, 7 in 2 to 3 years, 2 in 3 to 4 years, 3 in 5 to 6 years, 1 in 6 to 7 years. Three were lost trace of, 1 after having palliation for 2 years, 1 after being clinically well for 1 year 5 months, 1 who was unimproved after treatment for 1 year. Eight are still alive, 1 for 4 years but is now in the terminal stages of the disease, 1 for 3 years 4 months, feeling well, 1 for 1 year 9 months who is having palliation, 5 for less than a year since admission, 2 are having palliation for 10 months and 11 months, respectively, and 3 are not improving. Thirty-one cases are available for 5 year statistics, 4 or 12 per cent lived 5 years or more. Thirty-nine cases are available for 3 year statistics of which 8 or 20 per cent have lived 3 years or more.

TABLE XVIII—HODGKIN'S DISEASE

Cases	Ages	Cases
5	18	3
6	19	0
7	20	1
8	21	2
9	22	1
10	23	0
11	24	0
12	25	0
13	26	2
14	27	1
15	28	1
16	29	0
17	30	2

One occurred in a 10 month old female following injury. The tumor involved the left temporal region and orbit, was hard and seemed attached to the bone but X ray plates showed no destruction of bone. Section was taken but this tumor could not be definitely classified. Treatment was by means of 200 kilovolt X rays. She died 2 years 3 months after admission from sarcomatosis.

Table XVI shows the ages and sex of the sarcomata, excluding the bone sarcomata. The total number of cases of Hodgkin's disease admitted to the institute up to October 1, 1933, was 137, 64 of these were in patients 30 years of age or younger as shown in Table XVII, 39 males and 25 females.

Hodgkin's disease is a disease of the reticulo-endothelial system which is looked upon by some authorities as an infectious granuloma and by others, at least at times, as of distinct neoplastic origin, namely Hodgkin's sarcoma (Luing). Hodgkin's disease may occur at any age, 47 per cent of our cases occurred before the age of 30. It is characterized by a large variety of symptoms. Zeigler, as quoted by Luing, recognized an acute or chronic form. The duration varies from a few weeks in acute cases to many years, but is usually about 18 months. In this disease the origin may be in the lymph nodes anywhere in the body but frequently in the beginning involves the cervical lymph nodes. Eventually most cases show a generalized involvement, progressive ane-mia, chlorotic type or even sometimes assuming a pernicious type. In our experience, blood examinations showed loss of haemoglobin and red blood cells, the leucocytes varied from 2,500 to 128,000 but, contrary to some authors, lymphocytosis or eosinophilia

TABLE XVIII—LEUCÆMIA, AGES

Age	5	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Lymphatic leucæmia		2			1		2	1	1	1					1						2	1
Chloroma	1																					
Myelogenous leucæmia									1				1		1					2	1	1

## LEUCÆMIA

There were 20 cases of leucæmia in patients under 30 years of age: 11 lymphatic leucæmias, 1 chloroma, and 8 myelogenous leucæmias (See also under lymphosarcomata, 4 cases with aleucæmic blood pictures)

Table XVIII shows the ages of these patients: 11 males, 7 females

The patients suffering from lymphatic leucæmia complained of weakness, loss of weight, pain in various parts of the body, and epistaxis. The majority of these patients suffered from their symptoms for only a few months. Upon examination there was found enlargement of the cervical axillary, and inguinal nodes and enlargement of the spleen and liver. The original counts showed the hæmoglobin ranged from 10 to 70 per cent, red blood count from 604,000 to 5,020,000, leucocyte count from 29,000 to 525,000, lymphocytes from 79 to 98 per cent. Under X ray treatment a marked drop in leucocyte counts was noted. All of the patients in this group died within 6 weeks after admission. Six of the cases came to autopsy with the usual findings of a lymphatic leucæmia.

X ray treatments were given according to the total leucocyte count and the patient's general physical condition, doses of 25 to 40 per cent at 200 kilovolts. Patients were not treated if the total leucocyte fell below 30,000. Even in spite of this precaution, in a few instances, the reduction in the total leucocyte count continued until they showed a decided leucopenia.

The chloroma occurred in a 5 year old female.

Her blood count on admission was hæmoglobin (Sahli) 70 per cent, red blood count 3,776,000, leucocyte count 27,000, myelocyte 1 per cent, polymorphonuclears 63 per cent, lymphocytes 30 per cent, monocytes 6 per cent. Following treatment with 200 kilovolt X rays over the orbit, lumbar and sacral regions, the leucocyte count went down to 17,000 with a differential count of 64 per cent polymor-

phonuclears, 22 per cent small lymphocytes, 14 per cent large lymphocytes, and the patient was much improved for almost 3 months when the symptoms recurred and she succumbed to the disease 4 months after she was admitted to the hospital.

The patients suffering from myelogenous leucæmia complained of the same symptoms except that most of them noticed enlargement of the abdomen and the duration of their symptoms was for a longer period of time, that is, from 6 months to 1 year and 10 months.

The original leucocyte counts ranged from 140,000 to 332,000. Following irradiation with 200 kilovolt X rays, there was a reduction in the total leucocyte counts and reduction in the size of the spleen. These patients were not irradiated if their general condition did not warrant it or if the total leucocyte count was below 30,000.

One of the patients died in 23 days from intestinal hæmorrhage. The others lived from 5 months to 21 months. One patient is still alive 1 year after admission. At present the spleen is markedly enlarged and the leucocyte count is 187,000, although at one time it was as low as 12,600.

Two of these patients came to autopsy with the usual findings of myelogenous leucæmia.

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TABLE XVIII—LEUCÆMIA, AGES

Age	5	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Lymphatic leucæmia		1			1		2	1	1	1					1						2	1
Chloroma	1																					
Myelogenous leucæmia									1					1	1					2	1	2

## LEUCÆMIA

There were 20 cases of leucæmia in patients under 30 years of age: 11 lymphatic leucæmias, 1 chloroma, and 8 myelogenous leucæmias (See also under lymphosarcomata, 4 cases with aleucæmic blood pictures)

Table XVIII shows the ages of these patients: 11 males, 7 females

The patients suffering from lymphatic leucæmia complained of weakness, loss of weight, pain in various parts of the body, and epistaxis. The majority of these patients suffered from their symptoms for only a few months. Upon examination there was found enlargement of the cervical, axillary and inguinal nodes and enlargement of the spleen and liver. The original counts showed the hæmoglobin ranged from 10 to 70 per cent, red blood count from 604,000 to 3,020,000, leucocyte count from 29,000 to 525,000, lymphocytes from 79 to 98 per cent. Under X-ray treatment a marked drop in leucocyte counts was noted. All of the patients in this group died within 6 weeks after admission. Six of the cases came to autopsy with the usual findings of a lymphatic leucæmia.

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phoneuclears, 22 per cent small lymphocytes, 14 per cent large lymphocytes, and the patient was much improved for almost 3 months when the symptoms recurred and she succumbed to the disease 4 months after she was admitted to the hospital.

The patients suffering from myelogenous leucæmia complained of the same symptoms except that most of them noticed enlargement of the abdomen and the duration of their symptoms was for a longer period of time than 18, from 6 months to 1 year and 10 months.

The original leucocyte counts ranged from 140,000 to 332,000. Following irradiation with 200 kilovolt X-rays, there was a reduction in the total leucocyte counts and reduction in the size of the spleen. These patients were not irradiated if their general condition did not warrant it or if the total leucocyte count was below 30,000.

One of the patients died in 23 days from intestinal hæmorrhage. The others lived from 5 months to 21 months. One patient is still alive 1 year after admission. At present the spleen is markedly enlarged and the leucocyte count is 187,000, although at one time it was as low as 12,600.

Two of these patients came to autopsy with the usual findings of myelogenous leucæmia.

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# A STUDY OF THE ACTION OF ERGOT ON THE HUMAN PUERPERAL UTERUS<sup>1</sup>

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THE uncertainty concerning the therapeutic effects of various ergot preparations on the human uterus has led some clinicians to question their clinical value. A number of factors contribute to this uncertainty. The nature of the active principles of ergot has been the source of much controversy during recent years. It follows, therefore, that since the active elements have not been conclusively established the standardization of activity is difficult. This difficulty is increased by the fact that uteri in different physiological states of the same species, and in the same physiological states in different species often give divergent results with the same agent. Again, findings *in vitro* and *in vivo* do not always correspond. It is obvious that the most desirable form of confirmation of experimental findings lies in their clinical applicability. The following study was undertaken in order to investigate the relative clinical value of various ergot preparations.

A study of its history shows that ergot has some oxytocic effect on the human uterus. It was first described in Adam Lonicer's *Kreuterbuch* published in 1582 where it was mentioned as "a proved means of inducing pains of the womb." In the 17th and 18th centuries midwives in most of the European countries used homemade preparations of ergot to stimulate labor pains. However, it was not introduced into official medicine until the early part of the 19th century. In 1808 there appeared in *The Medical Repository of New York* an account of "Pulvis Parturiens," a remedy for quickening childbirth. This was published in the form of a letter from Dr. John Stearns then a practitioner in Saratoga County, New York. Four years later Dr. Oliver Prescott of Boston read a "Dissertation on the Natural History and Medicinal Effects of Ergot." Subsequently ergot was used widely by physicians in this country to stimulate labor and to control postpartum

hæmorrhage. Today, of course, the dangers of administering ergot before the termination of labor are well known, and its use during this process has fallen into disrepute.

The original edition of the *U. S. Pharmacopoeia* in 1820 was the first official publication to admit ergot as a drug. Since this time a large amount of chemical and pharmacological work has been done to determine the nature of its active principles. It has been generally accepted that the activity of ergot lies in the alkaloidal fraction. Alkaloids were first shown to be present by Wenzell in 1864, but none was obtained in a state of purity until Tanret, in 1876, crystallized ergotamine, which proved to be practically inactive. Barger and Carr, in 1906, isolated an alkaloid in the form of a crystalline salt, named ergotoxine. In the same year, Kraft showed this alkaloid to be a hydrate of the ergotamine described by Tanret. Ergotoxine was investigated by Barger and Dale who believed it to be the active principle of ergot because of its ability to stimulate smooth muscle, and particularly uterine muscle, of the experimental animals used. Stoll, in 1918, discovered a third alkaloid, ergotamine, which has a physiological activity indistinguishable from ergotoxine (Dale and Spiro, 1922; Morr, 1932). Until recently both ergotoxine and ergotamine were generally recognized as the active oxytocic principles of ergot. Still another ergot alkaloid, sensibamin, has recently been placed on the market as an oxytocic.

Much interest was aroused when Morr, in 1932, working on the human puerperal uterus, found that aqueous ergot preparations, such as the fluid extract of the British *Pharmacopoeia* showed an oxytocic effect far out of proportion to the amount of ergotamine and ergotamine present. This interested us in particular, since we have been using both aqueous and alcoholic preparations of ergot with apparently equally good clinical results.

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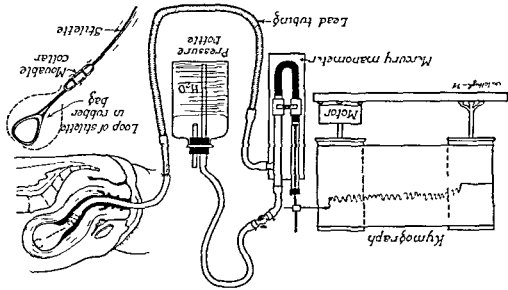


Fig. 1 Diagram of apparatus used showing position of hydrostatic bag in uterus. Stilette prevents bag from slipping down into cervix.

method described by Bourne and Burn in 1927, and further elaborated by Alor in 1932, was used. A sterilized watch-shaped rubber bag was introduced through the cervix into the uterus by means of a stilette. The bag was connected by lead tubing to a mercury manometer which was fitted with a float and marker for recording contractions on a revolving smoked drum. The bag was inflated with water to a pressure equivalent to 20 millimeters of mercury (Fig. 1).

Sixty-two satisfactory experiments have been executed, and the following preparations have been tested in the stated number of cases

- 1 Fluid extract of ergot U S P—10 cases
- 2 Ergotole—8 cases
- 3 Ergotamine tartrate—10 cases
- 4 Ergotamine ethane-sulphonate—8 cases
- 5 Emlin (a preparation which contains histamine, tyramine and ergotamine) 3 cases
- 6 Histamine—4 cases
- 7 Sensibamin—6 cases
- 8 An ergot preparation from which all the alkaloids were removed—4 cases
- 9 A preparation which contained all the alkaloids of ergot—4 cases
- 10 A preparation containing the alkaloids of ergot except ergotamine—2 cases

When assayed for the specific alkaloids by the Broom Clark method, the aqueous preparation, ergotole, contained not over 0.15 milligrams per cubic centimeter while the alcoholic preparation, fluid extract of ergot U S P contained over 0.5 milligrams per cubic centimeter, both in terms of ergotamine as a standard.

A review of the literature shows that the accuracy of conclusions drawn from clinical observations on the efficacy of these ergot preparations is subject to doubt. Therefore, it was decided to determine by a more direct method the relative oxytocic value of an aqueous extract (ergotole), U S P fluid extract of ergot, and various other ergot preparations containing the isolated and presumably active alkaloids, ergotamine, ergotamine, sensibamin

#### METHOD AND MATERIAL

The experiments were performed during the normal puerperium on patients who had had short uncomplicated labors and afebrile postpartum courses. This group of cases was chosen for two reasons first, because ergot preparations are used mainly during the puerperium, and second, because there was less danger of infecting the patient. In order to make results more comparable, each experiment was performed on the fifth or sixth day of the intake of food.

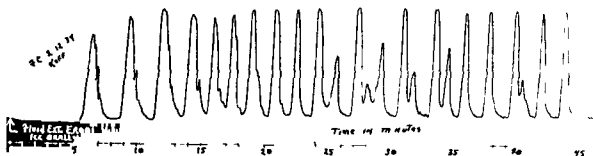


Fig 2 Fluid extract of ergot USP 1 cubic centimeter (equivalent to 0.5 milligram specific alkaloids by assay). Oral administration. Onset of contractions in 5½ minutes. Rise above base line indicated slight tonus. Regular and intermittent contractions lasted over 2 hours.

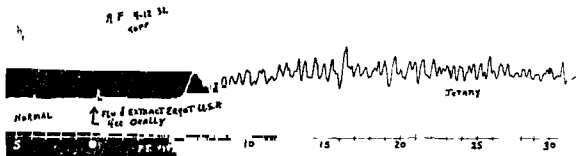


Fig 3 Fluid extract of ergot USP 4 cubic centimeters (equivalent to 2.0 milligrams specific alkaloid by assay). Oral administration. Contractions began in 6 minutes. Rise above base line indicated sustained tonic contractions. This is typical fluid extract curve. Duration of tetany 1 hour and 59 minutes.

11 A synthetic preparation resembling fluid extract of ergot—3 cases

In most cases a different patient was used for each test because the long duration of the action of some of these preparations prevented the recording of two experiments on one individual. No 2 patients produced exactly the same type of tracing. One uterus was entirely inactive, another very active. In general three types of physiological reactions occurred: (1) Very active uteri showed contractions every 2 to 3 minutes. (2) Moderately active uteri showed strong contractions every 15 to 20 minutes. (3) Inactive uteri showed occasional weak contractions or none at all.

The effects of these ergot preparations are illustrated on the inactive uterus only since the results are more comparable. When pos-

sible each ergot preparation was tested by oral, subcutaneous, intramuscular, and intra-venous administration.

#### ORAL ADMINISTRATION OF ERGOT PREPARATIONS

From Figures 2 and 3, it may be seen that fluid extract of ergot standardized to contain 0.5 milligrams per cubic centimeter of specific alkaloids produced the expected degree of oxytotic effect. However, ergotole, (Figs 4 and 5) an aqueous preparation containing not over 0.15 milligrams per cubic centimeter (¼ the value in terms of specific alkaloidal content) produced almost exactly the same effect from the standpoint of the onset, duration, and degree of tonic contractions of the uterus. It is surprising, as Mour (1932) pointed out, that

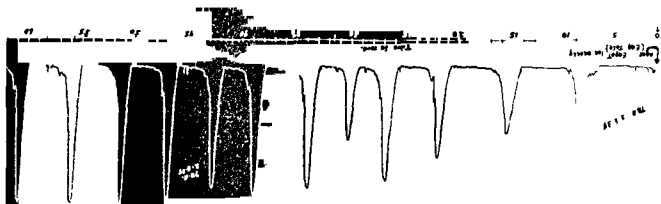


Fig 4 Aqueous extract (ergotol), 1 cubic centimeter (equivalent to 0.15 milligram specific alkaloids by assay). Oral administration. Contractions began in 9 minutes. Absence of rise above base line indicated lack of tonic increase (compare with Fig. 1). Contractions continued for over 2 hours.



Fig 5 Ergotol, 4 cubic centimeters (equivalent to 0.6 milligram specific alkaloids). Oral administration. Contractions began in 14 minutes. Rise above base line indicated sustained tonic contractions. Duration of tetany 1 hour and 6 minutes.

aqueous preparations of ergot which contain very small amounts of the presumably active principles should have an oxytocic effect that is so great. Our experiments have demonstrated that this effect is far out of proportion to the amount of the so called specific alkaloids present in solution (Fig. 6). The observations recorded in Figures 6, 7, 8, and 9 indicate that ergotamine, ergotovine, and sensibamin given by mouth, even in large doses, do not exert rapid or great enough oxytocic effect to be of clinical value in obstetrics. This work substantiates the statement of Mor that "Oral administration of ergotovine did not yield consistent results." We wish to

draw particular attention to Figure 8 which compares the effect of 2 milligrams of the specific alkaloid ergotamine tartrate with that of 4 cubic centimeters of the aqueous preparation (4 cubic centimeters contains 0.64 milligrams of specific alkaloid). Here, the rapid and powerful effect of the aqueous preparation when compared with the absence of any effect from administration of the specific alkaloid is striking evidence that ergotamine is not responsible for the major oxytocic action of ergot. On the basis of pharmacological investigation, it has been generally accepted that ergotovine, or ergotamine, was essential for the efficacy of ergot preparations. Preparations

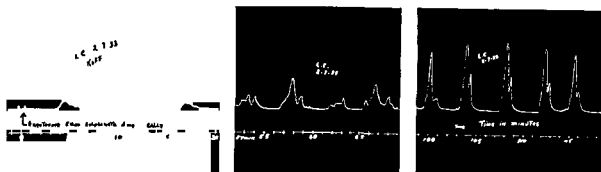


Fig 6 Ergotoxine ethane sulphonate 3 milligrams orally Onset of contractions occurred in 54 minutes No sustained rise above the base line indicated lack of tonus increase Contractions are intermittent and irregular (Three milligrams of ergotoxine is equivalent by assay to 20 cubic centimeters aqueous preparation) Tracing was continuous but only sections of it are shown as indicated by the record

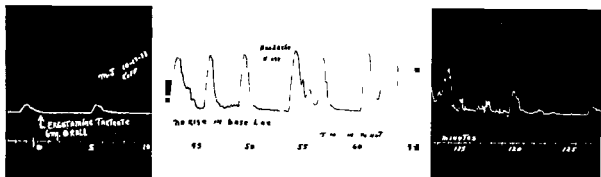


Fig 7 Ergotamine tartrate 6 milligrams orally Contractions began in 43 minutes No rise above the base line indicated lack of tonus increase Duration of contractions was 2 hours (Six milligrams ergotamine is equivalent to 12 cubic centimeters U S P fluid extract of ergot)

containing negligible quantities of these alkaloids were therefore considered inert by many authorities. Contrary to this opinion, administration of aqueous preparations containing insignificant amounts of the specific alkaloids produces a degree of uterine muscle spasm considerably in excess of that produced by the alkaloids ergotoxine, ergotamine, and sensibamin. This suggests that ergot may contain a substance hitherto unidentified which is responsible for the major oxytocic effect.

In general it may be said that when given orally in proper dosage (4 cubic centimeters or over) both the aqueous preparation ergotole, and U S P fluid extract of ergot produce a rapid and powerful oxytocic effect. On the other hand, the action of ergotamine, ergotoxine, and sensibamin by oral administration is so slow and inconsistent that the clinical use of these drugs when given by mouth seems of doubtful value.

#### INTRAMUSCULAR ADMINISTRATION OF ERGOT PREPARATIONS

It has been possible to obtain consistently good results by intramuscular administration of these alkaloids (ergotoxine ethane sulphonate, ergotamine tartrate [gynergen], sensibamin) only in doses of 2 milligrams or over (Figs 10, 11, and 12). In some of these cases, shortly after administration, the patients developed headaches, blurring of vision and nausea, particularly after the administration of ergotamine. The results shown here and the numerous clinical reports on ergotoxine and ergotamine leave no doubt that these alkaloids are effective parenterally. Nevertheless, these alkaloids were practically inactive by mouth, and administration by the intramuscular route was often associated with toxic symptoms. These facts render these drugs less valuable and less dependable. The fact that no symptoms occurred when large



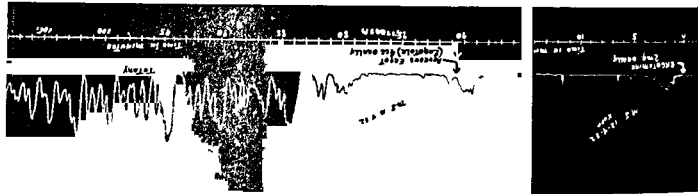


Fig 8 Ergotamine tartrate, 2 milligrams orally. No contractions during 1 hour. Four cubic centimeters aqueous ergot given to same patient for comparison of effect. Contractions began in 12 minutes. Marked rise in base line indicating tonic contractions. (Two milligrams ergotamine is equivalent by assay to 13 cubic centimeters aqueous ergot [ergotol].)

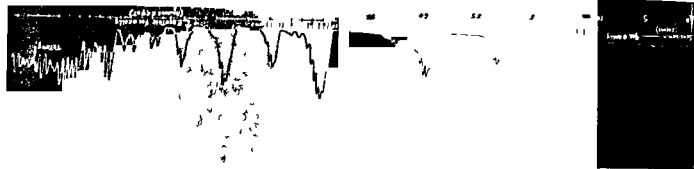


Fig 9 Sensibam, 4 cubic centimeters orally. Contractions began in 30 minutes. No rise in base line. Four cubic centimeters ergotol given as control. Onset of contractions in 6 minutes followed by strong tetany. Only sections of tracings are shown.

doses of ergotamine and ergotamine were given by mouth would seem to indicate that these alkaloids are probably very slowly absorbed from the intestine. Burn, in 1929, estimated that something like 30 per cent is absorbed from the cat's intestine. Nevertheless, taking this into consideration one should obtain better results than those heretofore shown from the large doses administered by mouth.

It has been claimed by some authors (Jaeger, 1913) that the oxytocic effect of ergot is due to histamine. Thompson found in a series of 10 ergot samples a percentage of histamine ranging from 0.012 to 0.150. In our experience histamine exerted no oxytocic effect by mouth, and only a transitory effect when given intra-

muscularly, as was emphasized by Thompson in 1930 (Fig 13).

It is clear from this study that when given preparations which contain not more than orally and subcutaneously aqueous ergot

oral administration of ergot fractions testing

The chemical and pharmacological details regarding these fractions were presented before the scientific section annual meeting of the American Pharmaceutical Association at Washington, D. C. and are in press

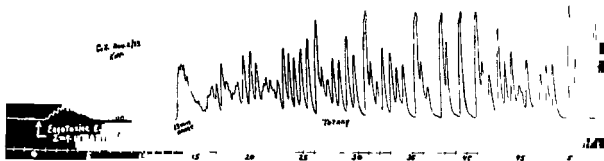


Fig 10 Ergotamine ethane sulphonate 2 milligrams intramuscularly Contractions began in 13 minutes Rise above the base line indicated increase in tonus Tetany for 34 minutes followed by strong intermittent contractions

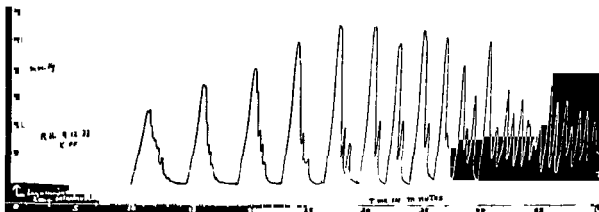


Fig 11 Ergotamine tartrate (gynergen) 2 milligrams intramuscularly Contractions began in 10 minutes Contractions at first strong and intermittent followed by a period of tetany lasting 65 minutes

1 Alkaloid free fraction containing essentially all extractives of ergot except the total alkaloids (Fig 14)

2 Total alkaloidal fraction remaining after removal of fraction 1 (Fig 14)

3 A fraction resulting after the chemical removal of essentially all of the ergotamine, ergotinine and ergotaminine from fraction 2 (Fig 15)

Each fraction was made up so that the dosage of 1 cubic centimeter was equivalent to its amount in 1 gram of crude ergot

From Figure 14 it may be seen that the fraction of ergot that did not contain alkaloids was absolutely inactive Since the alkaloidal fraction did produce as rapid and powerful an effect as that obtained by oral administration

of aqueous and alcoholic whole extracts of ergot one may say unequivocally, that the activity of ergot lies in, or is associated with, this alkaloidal fraction (Fig 14) It is probably true that during the process of extraction some of the activity is lost It is evident, as shown in Figure 15 that even though the ergotamine was removed the remaining alkaloidal fraction had a high degree of activity As far as we can make out this alkaloidal fraction is responsible for most of the oxytocic action of ergot

#### EVALUATION

It is the custom of most obstetricians to prescribe ergot preparations following the third stage of labor in order to produce tonic contractions of the uterus The objects of

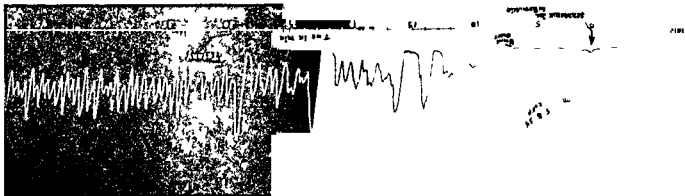
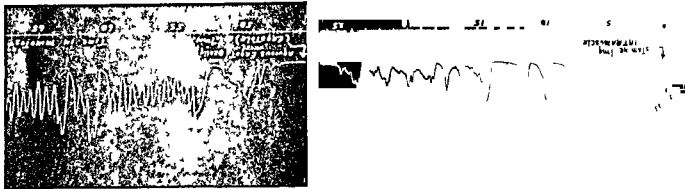


Fig. 12 Sensibam, 2 cubic centimeters intramuscularly. Contractions began in 6 1/2 minutes. Rise in base line indicated tetany which lasted 6 minutes followed by weak, irregular contractions. Comparison of the effect of 4 cubic centimeters ergoloid on the same patient. Tracing is continuous but only parts are shown.



this treatment are mainly to control immediate and delayed postpartum bleeding, to favor involution of the uterus, to diminish the likelihood of postpartum infection by expelling retained lochia. Moreover, in some clinics ergot preparations are given in order to complete abortions in cases in which secun- daries are retained. Practically all authorities deprecate strongly the use of ergot during any stage of labor, mainly because of the danger of rupture of the uterus and asphyxia to the child due to tetanic contractions of the uter- ine muscle.

It should be stated here that we consider an oxytocic drug clinically valuable when its action is rapid and consistent, and the con- tractions are tetanic and of long duration. For the control of hemorrhage, rapid action and tetanic contractions are obviously necessary. Any drug that produces only intermittent contractions will allow bleeding to take place during the intervals and is therefore of little value. It is generally stated that drugs which exert a prolonged and tetanic effect are more desirable in furthering involution. This opinion is probably based on the observation that postpartum uteri involute more rapidly when strongly contracted.

The task of evaluating clinical reports on the merits of various ergot preparations is difficult mainly because a large number of the constituents extractable from the crude drug exert a greater or lesser degree of oxytocic effect. Numerous attempts have been made to isolate the specific or active principles, and on the basis of the pharmacological results on laboratory animals most of these extracts have been given a fair clinical trial. These extractable constituents of ergot were classi- fied by Thompson (1930) as follows:

- 1 Specific alkaloids such as ergotoxine, ergotamine, ergotamine, and ergotamine tyramine, acetyl choline
- 2 Non-specific amines such as histamine, 3 inert extractions. These consist of one or more pigments, 10 to 35 per cent of fixed

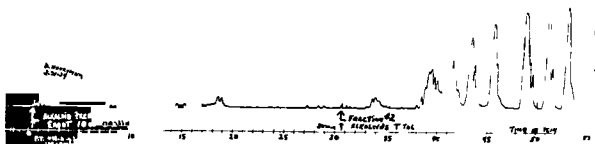


Fig 14 Fraction 1 (alkaloid free) 10 cubic centimeters orally. There was no stimulation of uterine muscle indicating lack of oxytocic activity. Compare effect of 4 cubic centimeters alkaloidal fraction No. 2. Contractions began in 8 minutes. Strong intermittent contractions with marked rise in the base line indicated uterine muscle spasm.

oil small amounts of inorganic salts and appreciable quantities of proteinogenous substances.

On the basis of pharmacological studies of the specific alkaloids only ergotoxine and ergotamine stimulate uterine contractions. Of the non specific amines histamine and tyramine exert a weak oxytocic effect.

Very few reports on the clinical action of ergotoxine are available. Kehrer (1911) found that injections of 1 to 2 milligrams were ineffective. Sharp (1911) found its action when injected more prompt but weaker than whole ergot preparations. Moir (1932) discovered ergotoxine to be very active when given parenterally but practically inactive by mouth. Using muscle strips from the human uterus, Robson (1933) found ergotoxine to be very active *in vitro*.

Jaeger (1913), Bourne and Burn (1927), and others found that hypodermic administrations of histamine stimulated the uterus during labor but noted unpleasant side effects such as headaches, flushing, and nausea. Kehrer (1911) on the other hand, was unable to confirm the findings of uterine stimulation. Using tyramine Heimann (1912) concluded that this drug produced a desirable oxytocic effect (without the toxic effects of histamine).

Since the isolation of ergotamine in 1918, numerous favorable clinical reports have appeared with both intramuscular, and oral administration of this drug. Hellman (1927) recommends ergotamine for postpartum hæm-

orrhage, incomplete abortion, menorrhagia, and metrorrhagia. According to this author, hypodermic and oral administration are of equal value. Turot (1923) makes the same recommendations and uses ergotamine successfully in the completion of incomplete abortion. Bourne and Burn (1927) state that ergotamine produced a powerful contraction of the uterus for 16 hours during the first stage of labor when 1 milligram was injected intramuscularly. Suchs (1932) found that gynergen (ergotamine tartrate) when given by mouth increased the rate of involution of the puerperal uterus. Moir (1932) discovered that ergotamine, when given by mouth, exerted a very weak effect, and was quite active when injected intravenously or intramuscularly. On the other hand, Adair and Davis (1934), also recording contractions by means of a balloon in the uterine cavity connected to a recording manometer, were unable to show any effect on the contractions or muscle tone of the uterus by injection of 1 cubic centimeter of gynergen intramuscularly.

One can readily understand that from these divergent results of clinical investigation it is difficult to draw very definite conclusions. Nevertheless, on the basis of the pharmacological and clinical data, both ergotamine and ergotoxine have become generally recognized as the active or specific principles mainly responsible for the major oxytocic effect of ergot. As a result, an attempt has been made to standardize ergot with respect



TABLE I.—RESULTS

Table I is a tabulation of 39 experiments all done on the sixth day of the puerperium. The uterus were inactive and practically in the same physiological state.

Drug	Dose	Mode of administration	Time of onset	Duration of tetany	Remarks
Fluid extract ergot U.S.P.	1 c.cm. (0.5 mgm.)	Oral	5 min	None	Intermittent strong contractions
Fluid extract ergot U.S.P.	2 c.cm. (1 mgm.)	Oral	3 min	Slight, 15 min	Intermittent strong contractions
Fluid extract ergot U.S.P.	3 c.cm. (1.5 mgm.)	Oral	0 min	1 hr 15 min.	Tetany followed by strong contractions
Fluid extract ergot U.S.P.	4 c.cm. (2 mgm.)	Oral	6 min	1 hr 50 min	Tetany followed by strong contractions
Fluid extract ergot U.S.P.	4 c.cm. (2 mgm.)	Oral	14 min	1 hr 53 min	Tetany followed by strong contractions
Fluid extract ergot U.S.P.	8 c.cm. (4 mgm.)	Oral	7 min	1 hr. plus	Tetany followed by strong contractions
Aqueous ergot (ergotole)	1 c.cm. (0.15 mgm.)	Oral	7 min	None	Strong contractions every 2 to 3 minutes
Aqueous ergot (ergotole)	2 c.cm. (0.3 mgm.)	Oral	12 min	Transitory	Strong contractions every 2 to 3 minutes
Aqueous ergot (ergotole)	4 c.cm. (0.6 mgm.)	Oral	14 min	1 hr 6 min	Tetany followed by strong contractions
Aqueous ergot (ergotole)	4 c.cm. (0.6 mgm.)	Oral	9 min	1 hr plus	Tetany
Aqueous ergot (ergotole)	4 c.cm. (0.6 mgm.)	Oral	7 min	1 hr 40 min.	Tetany followed by strong contractions
Aqueous ergot (ergotole)	4 c.cm. (0.6 mgm.)	Oral	6 min	20 min plus	Tetany
Aqueous ergot (ergotole)	5 c.cm. (0.75 mgm.)	Oral	0 min	1 hr 10 min	Tetany followed by strong contractions
Aqueous ergot (ergotole)	6 c.cm. (0.9 mgm.)	Oral	13 min	Over 2 hrs	Strong tetany
Aqueous ergot (ergotole)	8 c.cm. (1.2 mgm.)	Oral	7 min	1 hr 50 min	Strong tetany
Aqueous ergot (ergotole)	10 m. (1 mgm.)	Subcutaneous	14 min	30 min	Gradual onset of contractions
Aqueous ergot (ergotole)	10 m. (1 mgm.)	Intramuscular	10 min	40 min	Gradual onset of contractions
Ergotoxine ethane sulphate	1 mgm.	Oral	56 min	None	Occasional weak contraction
Ergotoxine ethane sulphate	2 mgm.	Oral	38 min	Transitory	Weak contractions every 3 min
Ergotoxine ethane sulphate	3 mgm.	Oral	34 min	Transitory	Strong intermittent contractions 2 to 3 min
Ergotoxine ethane sulphate	1 mgm.	Intramuscular	32 min	Transitory	Weak intermittent contractions
Ergotoxine ethane sulphate	2 mgm.	Intramuscular	43 min	1 hr	Strong contractions followed by tetany
Ergotoxine ethane sulphate	3 mgm.	Intramuscular	14 min	30 min	Gradual onset of contractions
Ergotoxine ethane sulphate	10 m.	Intravenous	12 min	30 min.	Gradual onset of contractions
Ergotamine tartrate (synergen)	2 mgm.	Oral	32 min	None	Weak contractions every 3 to 5 min
Ergotamine tartrate (synergen)	2 mgm.	Oral	43 min	None	No contractions in 1 hr 5 min.
Ergotamine tartrate (synergen)	6 mgm.	Oral	43 min	None	Strong irregular contractions disappearing in 2 hrs.
Ergotamine tartrate (synergen)	1 mgm.	Intramuscular	14 min	25 min	Gradual onset
Ergotamine tartrate (synergen)	2 mgm.	Intramuscular	11 min	65 min.	Gradual onset. Strong contractions followed by tetany
Ergotamine tartrate (synergen)	10 m. (6 mgm.)	Intravenous	8 min	20 min	Gradual onset
Sensibain (er gone)	4 c.cm.	Oral	30 min	None	Irregular weak contractions
Sensibain (ergone)	1 c.cm.	Intramuscular	12 min	Transitory	Good contractions
Sensibain (er one)	2 c.cm.	Intramuscular	6 min	1 hr 46 min	Strong contractions
Ernutin	2 c.cm. (1.2 mgm.)	Oral	51 min	None	Weak contractions
Histamine	1 mgm.	Intramuscular	13 min	6 min	Tetany followed by weak contractions
Histamine	2 mgm.	Oral	No effect	No effect	No effect
Alkaloidal free ergot fraction 1	10 c.cm. (0 mgm.)	Oral	No effect	No effect	No effect in 2 hrs
Alkaloidal free ergot fraction 1	15 c.cm. (0 mgm.)	Oral	No effect	No effect	No effect in 2 hrs
Alkaloidal fraction 2	4 c.cm. (2 mgm.)	Oral	8 min	40 min.	Gradual onset of tonic contractions
Alkaloidal fraction 3 moved	5 c.cm. (2.5 mgm.)	Oral	9 min	37 min	Tetany alternates with contractions
Alkaloidal fraction 3 moved	6 c.cm. (trace)	Oral	8 min	38 min	Tetany alternating with contractions

All preparations except those prepared by Dr M. Thompson were obtained from the Johns Hopkins Hospital pharmacy. Ergotole and fluid extract of ergot were assayed by the Broom Clark method. Ergotole contains not over 0.13 mgm per c.cm. of ergotoxine. Fluid extract Ergot U.S.P. contains not less than 0.5 mgm. per c.cm. of ergotoxine. Equivalents given in mgm. in this table are on basis of assay by the Broom Clark method.

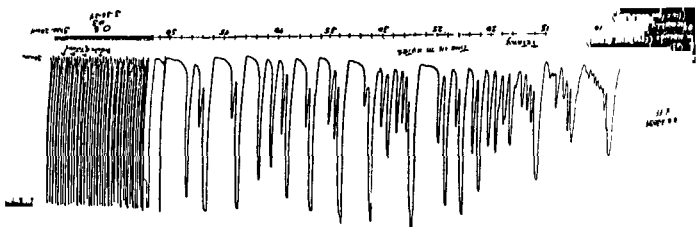


Fig 15. Fraction 3 (total alkaloids with most of the ergotoxine removed), 4 cubic centimeters orally. Contractions began in 13 minutes. Strong contractions alternating with periods of tetany lasted over 3 hours, 20 minutes

8 *Fractions* of ergot containing nothing but the total alkaloids exert an oxytocic effect, and to aqueous extract. This indicates that the active principle is either an alkaloid, or some chemical substance closely associated with the alkaloidal fraction.

9 Alkaloidal fractions, *ergotoxine* having been removed, exert an oxytocic effect identical with that produced when ergotoxine is present. This indicates that ergotoxine is not responsible for the major effects.

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- 2 Oral administration of ergotoxine, ergotamine, and sensibamin give slow and variable results. The onset of their action varies between 25 and 55 minutes. The contractions are weak and irregular and tonus is absent. These drugs given by mouth are of no clinical value in the puerperium.
- 3 *Iguenon, ergot preparations* induce an activity far out of proportion to the amount of the hypertonic specific alkaloids present in the solution. This fact suggests that ergot also contains an unidentified active principle.
- 4 Ergotoxine, ergotamine, and sensibamin by intramuscular and intravenous routes are indistinguishable from each other in their oxytocic effect on the postpartum uterus. Dosage of 2 milligrams of these alkaloids by the intramuscular route in the majority of cases produces a good clinical effect, but unpleasant side effects with this dosage are occasionally experienced. In doses of less than 2 milligrams the results are often variable.
- 5 Fluid extract of ergot U S P, and aqueous extract (ergotole) produce a more rapid, stronger, and lasting effect by mouth than ergotamine, ergotoxine, and sensibamin when given by the intramuscular route.
- 6 Histamine, when given by mouth, is inactive, and by the intramuscular route has a rapid but slight oxytocic effect.
- 7 Fractions of ergot containing no alkaloids, as determined by the Thompson method of extraction, when given by mouth in large doses, exert no oxytocic effect.

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## THE PRESENT STATUS OF THE STERILITY OF SURGICAL CATGUT SUTURES

WITH PARTICULAR REFERENCE TO AMERICAN MADE CATGUT

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AS a result of his finding (6) virulent spore forming anaerobic bacteria of the gas gangrene group in a batch of catgut sutures used in the operative wounds of 5 patients in a New York City hospital and in whom fatal gas gangrene occurred—coupled with his recovery of the same organism from one of the fatal cases—a comprehensive study of the sterility of catgut was proposed by Dr Frank L. Meleney. His aim was "that it shall not be possible for anyone to buy on the market catgut that is not absolutely sterile" (4).

At the Clinical Congress of the American College of Surgeons in 1929 Meleney (4) reported the results of his preliminary study. He stated

The Hospital Standardization Committee of the American College of Surgeons promised that if the results of this study were entirely satisfactory they would recommend the products of only those firms which were willing to subject their goods to this test not occasionally but with specimens from every single sterilized batch of material. It was felt that all of the reputable firms would be willing to follow the lead in the matter and adopt the standard test and any firms which did not fall into line would find no market for their goods. If hospitals and doctors

the country over then followed the advice of the committee they could buy catgut with perfect confidence and perfect security and the risk of fatal accidents such as I have described would be reduced to a minimum.

Later, Meleney and Chatfield (5) submitted an effective test for the sterility of catgut and reported that the products of ten firms had been found sterile, while the sutures of seven firms proved to be non sterile when subjected to this test.

In view of this excellent and comprehensive bacteriological study, it is most unfortunate that the Meleney and Chatfield technique was not adopted as a standard method to be enforced by some controlling authority. As so aptly stated by Meleney (4)

I believe that you will all agree with me in this, that there should never be any competition of catgut firms in the matter of sterility. Their products may vie with one another with respect to other physical characteristics—tensile strength, absorbability and what not, but they should all have the common factor of sterility. There is no relativity about sterility, it is an absolute term which means the absence of living elements.

For the purpose of determining the practical value of the Meleney and Chatfield test for





also in 1930 and 1932. Two of these non sterile brands made by Manufacturers A and F were found non sterile also in 1931 and 1933. Two non sterile brands, marketed by Manufacturers L and G, were also non sterile in 1931. The other non sterile brand marketed by Manufacturer I was non sterile also in 1933 (see Table II).

#### THE NEED FOR STERILITY CONTROL

This investigation which involved the bacteriological testing of several thousand of catgut sutures and which extended over a period of 5 consecutive years has demonstrated the value of the standard bacteriological test proposed by Meleney and Chatfield. When used with the three additional controls and the special neutralizing solutions which I previously reported (2) their bacteriological test has been found to be an efficient and reliable test for the sterility of surgical catgut sutures.

The results of my investigation of the sterility of American made catgut sutures have demonstrated conclusively two important facts: first that in spite of the widespread interest manifested in Meleney's study of catgut sterility and his recommendation for its control, there are still being marketed several brands of American made catgut sutures which are non sterile, and second that the need for an adequate control of the sterility of catgut sutures manufactured and sold in America and which was apparent in 1929 still exists.

In 1931 the American Medical Association appointed a Committee on Catgut Standards for the purpose of studying and recommending a suitable sterility standard and a method of enforcing compliance with such a standard by some established authority. A report from this Committee has not yet been published and non sterile catgut sutures continue to remain a menace to the surgical and hospital professions and to surgical patients, as indicated by the results herein described.

In Great Britain, the Therapeutic Substances Regulations prescribe a bacteriological test to which specimens taken from every lot of sutures sold in that country must be submitted. However, the Regulations unfor-

tunately do not provide for the use of special neutralizing solutions, so that chemically sterilized sutures, which are not actually sterile but in which bacterial activity has been inhibited will pass the test. This was demonstrated in my recent research work on the sterility of foreign made catgut sutures (3), wherein I showed that non sterile sutures are being manufactured and sold in England, and that similar conditions exist in France, Germany, Japan, and Spain. Hence, there is a world-wide need for the control of catgut sterility.

In this connection, however, it should be pointed out that Great Britain, following the exhaustive survey of catgut sterility by Bulloch, was quick to recognize the importance of controlling the sterility of catgut sutures, as evidenced by the prompt enactment of the Therapeutic Substances Regulations of January 17, 1930. Much credit is due Great Britain for having been the first country to take such decisive and constructive action toward safeguarding the interests of the surgical and hospital professions. If and when the United States of America adopts a standard test for the sterility of catgut sutures, it should profit by the experience gained as a result of the British Regulations by making the test sufficiently comprehensive to detect chemically sterilized sutures which contain viable bacteria whose activity has been merely inhibited by the chemical treatment. This can be accomplished by incorporating the necessary neutralizing solutions (2) as part of the technique prescribed in the test.

#### SUMMARY AND CONCLUSIONS

1. During a period of 5 consecutive years including 1930, 1931, 1932, 1933, and 1934, a total of 605 lots comprising 6,184 sutures and embracing twelve brands of American made catgut was subjected to a rigid bacteriological study. The products of Manufacturers A and F were found to be uniformly non sterile in each of five consecutive years. Two brands made by Manufacturers L and G, were non sterile in 3 consecutive years and then, after an interval of 1 year in which they were sterile, were again found non sterile, thus being non sterile in 4 non consecutive years.

sutures still exists, thus jeopardizing the reputations of the surgical and hospital professions, as well as the welfare and life of surgical patients.

5 Adequate control of the sterility of surgical catgut sutures in the United States of America by some recognized authority is of vital importance. It constitutes a serious problem, and one with which the surgical profession has been confronted for many years.

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## THE REACTION OF LIPIDS IN THE BLOOD LEUCOCYTES TO FEVER AND INFECTION

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SOME time ago there was begun in this laboratory a series of investigations on the fat metabolism of the white blood cells. The original purpose was merely scientific, to study variations, if any, in the several lipids which might be present in the blood leucocytes under conditions in which the latter are known to change numerically or histologically. As so often happens with research in "pure science," practical applications of the information thus derived became apparent from time to time. In so far as the present investigation has progressed to date, it has been

One brand, marketed by Manufacturer I, was non-sterile in 1930, and then, after proving to be sterile in 1931, was found non-sterile in 3 consecutive years, thus being non-sterile in 4 non consecutive years. The other non-sterile brand, the product of Manufacturer J, was non-sterile in 2 non-consecutive years (see Table II).

2 Based on the results of this investigation, it seems fair to assume that all catgut manufacturers in America are not using the bacteriological test proposed by McEweny and Chatfield (5), or, if so, they are not employing the special neutralizing solutions recommended (2) as a preliminary step in the technique.

3 Apparently, the publication of the results of McEweny's study of catgut sterility has had little or no effect in ridding the market of non-sterile sutures, for, during each of the 5 consecutive years since his preliminary report was made, non-sterile sutures have been marketed by several American catgut manufacturers.

4 The results of this extensive bacteriological examination of American made catgut sutures carried out over a period of 5 consecutive years, as herein described, have proved conclusively that the danger of non-sterile

the leucocytes from blood plasma and the erythrocytes was described in the next paper (5) and is in many respects the most difficult step of the whole procedure. Were it possible to remove a liter or more of blood from men or women and repeat this at intervals of hours or days without any ill effect on the health or physiology of the subject it would be a simple matter to obtain enough white blood cells for lipid analysis—white cells which were entirely free from the last trace of plasma or red cells. Obviously removal of such large amounts of blood is not practical. Even if it were so, it is probable that large venesections would of themselves affect the subsequent lipid content of the leucocytes, since hæmorrhage is known to produce a marked lipæmia in blood plasma (1).

Since repeated venepunctures were to be necessary in order to follow changes in the leucocytic lipids it was decided at the beginning of this series of investigations that the method to be adopted should require not more than 50 cubic centimeters of blood. Subsequent analyses have shown that the amount of blood required depends upon the leucocyte count. When the count is 10,000 to 15,000, 25 cubic centimeters of blood suffice, 15,000 to 25,000, 20 cubic centimeters, and over 25,000, 10 to 15 cubic centimeters. In cases of leucæmia with a white cell count of 100,000 to 400,000, as low as 5 cubic centimeters of blood have been used. The citrated blood is centrifuged and the white cells removed and weighed as previously described (5). No attempt is made to purify the leucocyte fraction for two reasons: first because some of the cells would be lost and the amount of blood stated yields the minimum of leucocytes necessary for analysis, and second because washing the cells might dissolve some of their lipids, particularly phospholipid. The white cells thus obtained invariably have traces of plasma and red cells; they usually have a slight tan or reddish color. However, changes in the lipid content of this fraction of blood have been proved to be due to changes in the leucocytes themselves. This was done by analyzing the lipid content of blood plasma and the red blood cells of the same samples of blood from which the leucocytes were obtained. It was found that

a The total lipid of the leucocyte fraction was invariably higher than that in plasma or the red cells.

b The percentage composition of lipids in the leucocyte fraction was different from that in plasma and the red blood cells.

c Marked increases or decreases in lipid content of the leucocyte fraction were often accompanied by minor changes in plasma and red blood cells, frequently changes in the latter two were the opposite of those in the former.

d In a few cases sufficient blood was available to give samples of pure leucocytes. The fat content of these pure cells was within 5 to 10 per cent of that of the "leucocyte fraction" as routinely used.

For these reasons, changes in the lipid content of the "leucocyte fraction" of blood so obtained are considered to represent changes in the lipid content of the leucocytes themselves. For the same reasons it is felt that the true absolute changes in the white blood cells are even more extensive than have been found by analysis of the "leucocyte fraction." Contamination of this fraction with some plasma and red blood cells will tend to depress to some extent the marked changes occurring in the white blood cells. In the few cases in which pure leucocytes were secured, the white blood cells were found to contain 5 to 10 per cent more lipids than the "leucocyte fraction" of the same blood.

A further factor of prime importance to the present investigations was the fact that minute amounts of lipids, as low as half a milligram, may be accurately determined by the recent improved micro methods of lipid analysis. To W. R. Bloor and his associates go the major honors in the development of these micro methods. Their technique still requires considerable experience before reliable results are obtained. The study of leucocytic lipids was prefaced by an analysis of the various micro methods (4). A number of oxidative procedures were tried out, modified, and brought together, resulting in the production of a general procedure whereby all the known blood and tissue lipids could be simultaneously determined.

Having developed a suitable method of analysis, the next step was the presentation

in blood plasma and the red blood cells, a study has also been made of the variation in the lipid content of the white blood cells. The results, to be described, bear out the conclusion heretofore noted that the activity of the white blood cells may be determined by lipid analysis. In such a manner it will be shown below that a "turn for the worse" in fever patients may be predicted several days before clinical apparition. Apart from this practical application, the results are presented for their value in displaying the fat metabolism of the white blood cells during fever.

It will be unnecessary to review here the relation of the present line of work to previous histological and chemical studies on the white cells.

#### EXPERIMENTAL

The cases to be presented were all female patients, most of whom were on the gynecological divisions of the Strong Memorial Hospital. Blood for analysis of the white cells was obtained under fasting conditions, usually in the morning before breakfast. The leucocytes were separated, extracted, and analyzed by methods previously described (4, 5). The series includes a variety of severe fever conditions, a number in which the patients recovered normally and several in which the disease was prolonged or death occurred. The different reaction of the white blood cells in these 2 groups will be demonstrated below.

#### GROUP 1.—NORMAL RECOVERY FROM FEVER

CASE 1. Mrs. C. B., a 38 year old woman, who on September 3, 1933, induced an abortion upon herself following the missing of 2 menstrual periods. Five days later, on September 8, she complained of nausea and vomiting, coldness, and lower abdominal cramps. On entering hospital she was found to have a temperature of 38.8 degrees C with an elevated pulse rate and respiration. No growth was obtained from a blood culture but the urine was positive for Bacillus coli. The temperature began to "spike" and her general condition became serious. Examination revealed an extensive inflammatory reaction in the pelvis with abscess formation and signs of peritonitis. On September 21 and 27 she was given 2 blood transfusions of 500 cubic centimeters each, but her condition became worse. Clinically the outlook was grave.

On September 28 a sample of her white blood cells was obtained and analyzed. This revealed a phospholipid and free cholesterol content much higher

of a series of tests on the lipid composition of normal individuals (5). No obvious changes were encountered in the white cells of pregnant women (7) although the lipids of blood plasma were all elevated (6). If anything, there was a decrease in the leucocyte lipids during pregnancy, particularly in the neutral fat and cholesterol esters (7). Following parturition, however, there was a marked rise in the lipid content of the white blood cells due to an increase in phospholipid, free cholesterol, and neutral fat (7). This change did not appear to bear as direct a relation to lactation as to the involutional processes and repair. In contrast to this, the fall in plasma lipids during the puerperium was directly influenced by activity of the mammary glands. The increase in neutral fat of the white cells was taken to mean a scavenger action by these cells in removing the debris of the involuting uterus. The increases in phospholipid and free cholesterol were interpreted as signifying increased activity of the white cells in response to the infection agents at open surfaces.

This introduced a new concept that it was possible to determine the activity of the white cells by measuring their lipid content. As previously reviewed (7, 8), Bloom and his co-workers have shown that activity in a tissue causes an increase in its phospholipid content especially Bloom has augmented his original studies on this relation in the corpus luteum and endometrium of the sow by showing that the same relation holds in the case of muscular tissue (Bloom and Snider, 2).

Following this line of thought the lipid composition of the white blood cells was followed during convalescence from surgical operations. (8) It was noted that patients who exhibited a normal healthy postoperative course had a rise in the phospholipid and free cholesterol of the white blood cells. Severe postoperative infections and death were associated with fall-in values for phospholipid and free cholesterol and large amounts of cholesterol ester and neutral fat. The lipid variation in the former group was indicative of increased activity, in the latter group, decreased activity. In conjunction with a recent survey of the lipid changes during fever and convalescence

than the average normal, suggesting that she had a good response to infection by her white blood cells. Hence it was decided to perform a posterior colpotomy and relieve the pressure of pus in the pelvis.

The response to operation was striking. Her fever immediately subsided and she rapidly improved. A second analysis of the white blood cells was performed on October 2, the fourth day after operation, and a third on October 14. At the latter date she was well on the road to recovery, there was no drainage from the colpotomy tube and Dakin's irrigations returned clear fluid.

The following values were found on analyzing the white blood cells. For convenience the various lipids determined will be indicated by the following symbols—total lipid T L, total fatty acid T F A, neutral fat, N F, total cholesterol T C, ester cholesterol, E C, free cholesterol F C, phospholipid, P.

Date	T L	T F A	N F	T C	E C	F C	P
Sept. 28	1492	704	40	366	118	248	1003
Oct. 2	3508	1980	550	900	399	501	2790
Oct. 14	2423	760	0	828	475	403	1310

It may be seen that analyses of the white blood cells in this case revealed information of much value in determining the prognosis and treatment. On September 28 the patient appeared on the verge of death and clinically it was impossible to tell whether opening the pelvis would relieve her symptoms or hasten death. At that time the leucocytes were found to have activity greater than normal according to their lipid analysis. The phospholipid content was over 1000 milligrams per cent, the free cholesterol was 248 milligrams per cent contrasted to 190 for normals, neutral fat was low—40 milligrams per cent (normal around 500), and ester cholesterol was not elevated. The significant value was the high phospholipid which always indicates increased activity. Active tissue usually also contains increased amounts of free cholesterol, and low values for ester cholesterol and neutral fat and these added features also characterized the leucocytic lipids on September 28.

Hence it could be said from the lipid analysis that this patient had a good resistance to infection and that the symptoms were due to the mass of the infecting organisms present. When this was relieved by a posterior colpotomy, the active leucocytes rapidly overcame the remaining organisms. The analysis

of October 2, a few days after operation, indicated a further increase in the activity of the white cells as evidenced by a rise in phospholipid and free cholesterol. During convalescence, on October 14, the leucocytes still contained large amounts of these 2 lipids.

CASE 2 Miss A C, a 26 year old negress, gave a history of having had an abortion, complete, about 3 weeks previous to admission to hospital on a pregnancy of about 6 weeks' duration. She developed a fever and pain in the lower abdominal region, and on examination was found to have large tender masses in the pelvis. Her blood Wassermann was +, white cell count 22,300 (88 per cent polymorphonuclears), and she had a temperature of 38.5 degrees C.

On February 8, 1934, 1 week after admission, her white blood cells were analyzed and found to contain elevated values for phospholipid and free cholesterol and small amounts of ester cholesterol and neutral fat. With this evidence of increased leucocytic activity, the prognosis was good. However, the abscess failed to point quickly and the temperature kept rising each afternoon. On February 13 the analysis was repeated with essentially the same results. A posterior colpotomy was performed on February 17 and, as in Case 1, the patient immediately improved.

The following values represent the results of the lipid analyses.

Date	T L	T F A	N F	T C	E C	F C	P
Feb. 8	1605	928	230	377	57	270	1010
Feb. 13	1462	790	24	308	59	240	1000
Feb. 20	2500	1320	10	649	108	540	1860

The results of this case are practically identical with those of Case 1. Throughout the febrile period the white blood cells contained more phospholipid and free cholesterol and less neutral fat and ester cholesterol than the average normal. Thus although the patient appeared to have a severe infection, her response to operation was immediately favorable. During early convalescence there occurred a further rise in the leucocytic phospholipid and free cholesterol.

CASE 3 Mrs A F, a 43 year old woman, entered hospital a convalescent from scarlet fever complaining of lower abdominal pain. Examination revealed the presence of a large abscess in the cul de sac of the pelvis. Her temperature varied between 37.5 and 39 degrees C with an elevated pulse and respiration rate and a marked leucocytosis, 49,300 (93 per cent polymorphonuclears). The patient appeared very sick.



severe uterine bleeding. The menorrhagia was found, after investigation, to be due to endocrine dysfunction. She had an elevated temperature of 38.8 degrees C with a rapid pulse and respiration. The fever lasted a few days but quickly subsided under the usual treatment of rest in bed and forcing fluids. Only 1 lipid analysis was performed on this patient at the height of fever.

TL	TFA	NF	TC	EC	FC	P
2722	1562	96	440	68	373	2140

The results indicate an excellent response by the white blood cells to the infection of the bladder and renal pelvis. It was quite rational to predict that the patient would make a rapid recovery which she eventually did.

CASE 7. Miss G. K., a 31 year old woman treated for agranulocytic angina. This patient exhibited a pronounced tendency toward a leucopenia each time she menstruated and during these periods was especially liable to infection. A sample of blood was obtained before one of these periods to determine whether or not there was a disposition to inactivity on the part of the blood leucocytes. The following values were obtained:

TL	TFA	NF	TC	EC	FC	P
1374	87	399	263	52	210	618

Very little can be positively stated about this analysis except that the phospholipid content was in the low range of normals. The remaining values are near the means for healthy persons. This much can be said however, that the white cell count in this patient was low and was associated with no increase in the activity of the leucocytes present. Hence the total resistance to infection of this patient decreased greatly during periods of leucopenia.

CASE 8. Mrs. H. P., a 30 year old woman, was admitted to hospital 8 months pregnant with evidence of failing heart action consequent upon a rheumatic heart disease. On entering the obstetrical division she complained of dyspnea, pain over the precordium, and edema of the extremities. Her blood pressure was 160 systolic and 60 diastolic and the urine contained 2+ albumin and casts. The white blood cell count was 7,550.

On February 14, 1933, a Porro caesarean section was performed under nitrous oxide and ether anesthesia. Following the operation her temperature rose to 38 degrees C and she had some pain and distention in the abdomen. The white cell count rose to 17,550 of which 91 per cent were polymorphonuclear leucocytes. The patient's temperature

subsided in about a week, she recovered, and was discharged from the hospital 3 weeks after operation.

Samples of blood for lipid analysis were secured before operation and on February 17, 3 days after delivery, in the midst of the febrile reaction.

Date	TL	TFA	NF	TC	EC	FC	P
Feb 9	603	224	177	165	6	159	257
Feb 17	1174	1165	280	416	100	326	1402

The lipid analysis of February 9 depicted the blood leucocytes as containing small amounts of all lipids, a condition characteristic of the leucocytosis of pregnancy as described. The response to caesarean section and postoperative fever, however, was quite favorable. Phospholipid was increased more than 6 times while free cholesterol was doubled. When such a change occurs, it has been found that variation in neutral fat and ester cholesterol should not be considered in computing the activity of the white blood cells. The increase in phospholipid alone is sufficient to denote an increase in activity of the white blood cells. As a result of this augmented resistance to infection, the patient quickly recovered from the postoperative infection.

#### GROUP II—FEVER FOLLOWED BY COMPLICATIONS OR DEATH

CASE 9. Mrs. E. M., a 37 year old woman, was admitted to hospital with a high fever and a history of self induced abortion. On examination she was found to have a parametritis and pelvic abscess with signs of pelvic peritonitis. Her temperature was 39.8 degrees C, pulse rate 125, and respirations 30. Clinically the patient appeared similar to Cases 1 to 4 above. Analysis of the white blood cells revealed an entirely opposite state of affairs to the cases in Group I. The most important value again was phospholipid which was very low—300 milligrams per cent. Blood for lipid analysis was obtained just before a posterior colpotomy was performed in the hope of relieving the pus collection in the pelvis.

Following this operation the patient did not improve. Her temperature went even higher, she became irrational, and in a few days she died. The lipid analysis of the blood leucocytes just before operation yielded the following results:

TL	TFA	NF	TC	EC	FC	P
560	238	40	220	0	225	300

The important feature of this analysis is the extremely low value for phospholipid in spite of the marked fever. As already stated, low



values for phospholipid characteristic inactive and degenerating tissue. It is obvious in this case that the response of the white cells to infection was very feeble. And it may be noted that no organisms of marked pathogenicity, such as haemolytic streptococci, were found.

Case 10. Mrs T F, a 34 year old woman, was brought to hospital with fever and a multicentric abscessing to her husband, she was about 6 weeks pregnant and had an abortion induced upon her a few days previous to entering hospital. The patient had a temperature of 40.2 degrees C, pulse rate of 150, respiratory rate of 37, and a white count of 6,400 (88 per cent polymorphonuclears). She had obvious signs of peritonitis and blood culture revealed the presence of 250 haemolytic streptococci per cubic centimeter.

A sample of blood was obtained shortly after admission to hospital and several hours later the patient died. The following values were noted for the leucocyte lipids

TL	TFA	NF	TC	EC	FC	P
1383	605	0	635	506	129	410

Case 11. Mrs T F, a 21 year old woman, who entered hospital complaining of swelling and pain in her legs. She gave a history of having been delivered of a full term child about 6 weeks previous. In hospital she was found to have a temperature spiking from about normal in the morning to 40.5 degrees C in the afternoon. The left leg was swollen, hot, and tender, especially along the subcutaneous veins. A diagnosis of thrombophlebitis was made and the patient put on the usual treatment of rest in bed with elevation of affected leg and ice packs.

On February 2, 1934, a few days after admission, blood culture revealed the presence of 90 haemolytic streptococci per cubic centimeter of blood. The patient was transferred to the isolation ward and given repeated small blood transfusions of 250 to 300 cubic centimeters every other day. On February 7 the first sample of blood was obtained for lipid analysis. The white cell count remained low as at the beginning, varying between 6,000 and 8,000.

There are several features which mark these cells as being extremely inactive or degenerate. First, the level of phospholipid, as in Case 9, is very low—410 milligrams per cent for a patient with a marked fever. Free cholesterol was also low—129 milligrams per cent while the leucocytes contained large amounts of ester cholesterol—506 milligrams per cent. The high value for ester cholesterol suggests particularly degenerate cells. The response of the blood leucocytes to infection was evidently nil, and the patient died.

Date	TL	TFA	NF	TC	EC	FC	P
Feb 7	1358	2500	2060	291	120	171	337
Feb 13	1503	1360	881	237	0	254	185
Feb 15 (a)	938	500	323	183	0	190	413
Feb 15 (b)	836	451	119	211	0	213	406
Feb 19	1773	920	0	383	0	359	1390

The phospholipid content of the white blood cells in the initial stages of the infection were within normal limits and indicated a fair degree of activity on the part of the blood leucocytes in response to infection in spite of the low white cell count. A peculiar feature of these early analyses was the presence of large amounts of neutral fat. Whether or not this had any connection with the formation of thrombi in the veins is not known. The white cells separated from blood had a peculiar sticky or gummy consistency. The cells on February 15 may be seen to have lost much of their phospholipid and free cholesterol. It was shortly after this that thrombophlebitis developed in the other leg and the patient became clinically worse. Nevertheless a sample taken 1 or 2 days after this, on February 19, exhibited a sharp rise in phospholipid and free cholesterol. From then on the patient passed

analyses of the white cells were extremely interesting. This case is in many respects remarkable as being a patient with a haemolytic streptococcus infection of the blood who eventually recovered. The lipid analyses of the white cells were extremely interesting. This case is in many respects remarkable as being a patient with a haemolytic streptococcus infection of the blood who eventually recovered.

All of these were opened and drained and the patient eventually became afebrile and recovered.

On the same day the blood culture was reported negative. Shortly after, the patient developed a subphrenic abscess and several abscesses in the legs. February 19 the fifth lipid analysis was done and thrombophlebitis developed in the other leg. On the same day another release set in and a few days later the patient appeared slightly better clinically.

A few days later another release set in and a few days later the patient appeared slightly better clinically.

On this day the second recorded on February 15 (b). On this day the patient appeared slightly better clinically.

For this later blood is the second recorded on February 15 (b). On this day the patient appeared slightly better clinically.

The third lipid analysis was performed on blood obtained before transfusion on February 13. A fourth sample of blood was taken just after transfusion had been completed, the object being to see if the donor's blood had any immediate effect on the lipids in the leucocytes of the patient. The analysis for this later blood is the second recorded on February 15 (b). On this day the patient appeared slightly better clinically.

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into a stage of abscess formation and eventually recovered.

The effect of blood transfusion is indicated in the lipid analyses performed before and after transfusion on February 15. It may be seen that healthy blood from the donor produced a slight increase in phospholipid and free cholesterol and a more marked decrease in neutral fat. These variations indicative of increased leucocytic activity confirm the clinical observation that repeated small blood transfusions are beneficial in septicemia.

CASE 12 Mrs. A. B. a 36 year old woman was admitted on the medical division of the Strong Memorial Hospital with a marked fever. She was known case of chronic lymphatic leukemia and on examination was found to have a lobar pneumonia. Her temperature varied around 39 degrees C. with a pulse rate of 120. Blood examination revealed 255,000 white blood cells per cubic centimeter, 98 per cent of which were lymphocytes. The non-protein nitrogen of the blood was 36 milligrams per cent and her blood Wassermann was negative.

A sample of blood for lipid analysis was obtained on March 4, 1934 through the courtesy of Dr. D. J. Stephens of the medical department. The lipid composition of the white blood cells was

IL	TLA	NP	TC	EC	FC	P
1		28	11	5	111	4.8

The analysis indicated that the patient had a very low response to infection. The white blood cells contained small amounts of phospholipid and free cholesterol. It was later learned through Dr. J. S. Lawrence of the medical department that this patient died shortly after the above lipid analysis was performed. Such an issue was eminently predictable from the lipid analysis of the white blood cells.

In each of the cases just described, the one substance which exhibited the most striking changes was phospholipid. Increased activity of the white blood cells was always accompanied by rising or high values for phospholipid. A patient with an infection and a phospholipid content of around 1,000 milligrams per cent or higher in the white blood cells may be said to have developed an active resistance to infection and an excellent chance of recovery. If the phospholipid value is below 500

milligrams per cent in spite of the stimulus of infection then the outlook is definitely grave.

The use of this method as a means of measuring the activity of the white blood cells is thus really a functional and not a static test. What we are determining is the response of the blood leucocytes to infection, operation, parturition etc. etc., by analyzing for an increase or decrease in the phospholipid fraction. For this reason repeated analyses are of more value than single determinations, especially where we wish to follow changes in the activity of the white cells from time to time throughout a prolonged illness.

From the results of this and previous communications it has become definitely established that to estimate the functional activity of the blood leucocytes the only substance which need be determined is phospholipid. Determination of the other fatty substances, as already listed, will supplement the information derived from phospholipid analyses but is not necessary. Hence the test as now used routinely in this clinic consists in the determination of the phospholipid content only of the white blood cells.

Determination of the phospholipid content of the white blood cells may be performed on a sample of blood within a few hours. If the blood is obtained in the morning before breakfast the test may be completed in the early afternoon and does not require the continuous attention of the analyst. It does require some technical experience as do all micromethods for lipid analysis.

The procedure may be briefly outlined here, for more detailed information the previous papers discussed here, may be sought. Blood is centrifuged, the plasma drawn off, and the white cell layer lying on top of the red blood cells, removed with a pipette or pair of forceps. This is quickly weighed, ground up with clean sand and alcohol ether, 3:1, added with shaking. The residue is filtered off and discarded. The alcohol ether extract is then evaporated to dryness and the residue extracted with petroleum ether. From the petroleum ether extract the phospholipids are precipitated with acetone and magnesium chloride. The precipitate is dissolved in moist ether and transferred to glass stoppered flasks.

On the other hand, patients who died as a result of their infection were noted to have low phospholipid values in the blood leucocytes during the febrile period. The same was found true in a case of thrombophlebitis when correlations developed.

From this evidence and previous data it has become obvious that the activity of the white blood cells may be measured by determining their lipid content, especially the phospholipid fraction.

Data from one case suggests that a blood transfusion may increase the activity of the white blood cells.

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the solvent evaporated off, and the remaining phospholipid residue oxidized completely with chromic acid. From the amount of chromic acid thus required the amount of phospholipid present may be calculated.

## SUMMARY

The results of the present investigation in conjunction with previous reports demonstrate that the white blood cells undergo marked metabolic variations, as indicated by changes in their lipid content, in pregnancy, lactation, postoperative convalescence, fever, and convalescence from fever. The present report contains 26 complete differential analyses of the lipids in the leucocytes under fasting conditions in 12 cases of fever. In each analysis the lipids determined were free cholesterol, ester cholesterol, total cholesterol, phospholipid, neutral fat, total fatty acids, and total lipid. Oxidative micro methods were used.

The findings were grouped according to whether or not the resistance of the patients was sufficient to overcome the infection. In patients who recovered normally from fever due to a variety of causes, the white blood cells contained large amounts of phospholipid. There was generally also an increased value for free cholesterol with low figures for ester cholesterol and neutral fat. In these, convalescence was accompanied by a further rise in phospholipid.

# CLINICAL SURGERY

FROM THE WILLIS C CAMPBELL CLINIC

## AN OPERATION FOR REPAIR OF THE INTERNAL AND EXTERNAL LATERAL LIGAMENTS OF THE KNEE JOINT

WILLIS C CAMPBELL M D F A C S MEMPHIS TENNESSEE

THE ligaments of the knee joints have certain well known functions to perform and when they are mechanically impaired by complete or partial rupture or elongation, more or less disability may result. Definite lateral instability, from elongation or stretching of the lateral ligament, and also definite anterior posterior instability, from impairment of the crucial ligaments are consistent with an apparently normally functioning knee. However, such a knee is obviously more prone to injury from trauma than one not so affected. There are many instances in which ligament impairment does cause definite symptoms and disability which may be independent or associated with injuries of the semilunar cartilages or other derangements. There are also instances in which disability persists after removal of a cartilage which is due to rupture or elongation of ligaments. The lateral ligaments may be come relaxed following either acute trauma or repeated injury, as may occur after recurrent displacements of the cartilage or other internal derangements.

When the cartilages are involved well known classical symptoms will be found. When there

has been stretching or elongation of the internal lateral ligament tenderness will be present along the attachments of the ligament or at any point where rupture may have occurred, and symptoms of indefinite internal derangement and a feeling of instability may be noted. The same symptoms may be present on the outer aspect when the external lateral ligament is involved.

To determine lateral stability of the knee the joint is completely extended, the leg is then grasped by one hand just above the ankle while the other hand fixes the thigh. No motion will be present in a normal knee, if the internal lateral ligament is impaired, however, excessive abduction will be possible if the external, excessive adduction. Certain apparently normal individuals have hypermobile joints, in which case there may be more or less lateral motion present—an abnormality which can always be determined by comparison with the opposite knee.

The internal ligament is much more frequently involved than the external, in fact I have never seen a rupture of the external ligament requiring surgery.

The same procedure can be used to repair either or both sides, when indicated, but, as the internal ligament is the more frequently involved we shall describe the treatment as applied to impairment of that ligament. The technique is as follows:

A skin incision is made parallel with the quadriceps tendon, the patella and patellar tendon, from 2 or 3 inches above the patella to just below the tibial tubercle. The deep fascia is incised and the capsule exposed. A curved incision parallel with the patella and the upper surface of the tibia is made into the knee joint if internal impairment is suspected, and such attention given as may be required, after which the joint is closed. The repair of the ligament is accomplished by dissecting from the inner aspect a strip of fascia lata, about 0.5 inch in width and 4 inches in

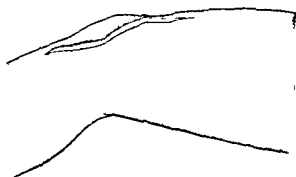


Fig 1. Internal incision parallel to patellar tendon which gives access to joint and also to internal lateral ligament.

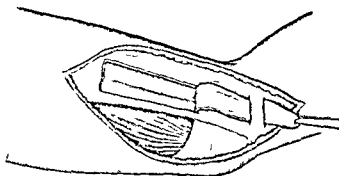


Fig. 2 Dissection of flap which is placed through tunnel down to the joint beneath the soft structures

length, from above down to a point about opposite the center of the inner aspect of the internal condyle of the femur. Two parallel incisions about 1 inch in length and about 0.5 inch apart are next made through the deep fascia and periosteum, about 1 inch below the upper extremity of the tibia and parallel with the joint line. An artery forceps is then passed through the lower incision close to the knee, emerging through the upper incision. The upper end of the fascial flap is grasped by the forceps and brought through the tunnel in the dense fascia and periosteum. After this the ligament is drawn tight and stitched as

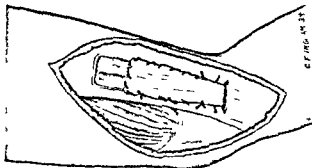


Fig. 3 Flap drawn very taut through tunnel and stitched in place, thus tightening the relaxed ligament

high as possible to the margin of the fascia lata from which it has been dissected. The limb is held extended and forcibly adducted during the operation. By passing the fascia through the tunnel a very accurate pulley action can be made, which permits effective tightening or tautness of the capsule. This operation has been used when there has been undue laxity of the ligament associated with injury of the cartilage, and also when there has been no cartilage unparment. The procedure has been employed for the past 2 years, and so far the results have been excellent in 3 cases.

## THE SURGICAL TREATMENT OF TUBERCULOUS EMPYEMA

R. H. MACDONALD M.D. F.R.C.S. (C) F.A.C.S. SASKATOON, SASKATCHEWAN

**B** tuberculous empyema is understood a collection of pus in the pleural sac wherein the primary causative agent is the tubercle bacillus. I frequently however, various other pyogenic organisms become associated and a resulting secondary infection is superimposed.

## CLASSIFICATION

From the standpoint of surgical treatment two main groups may be recognized: (1) tuberculous empyema; (2) tuberculous empyema with secondary infection.

Hedblom and other writers divide the tuberculous form into two types: (1) primary, without clinical evidence of associated pulmonary tuberculosis; (2) secondary, where there is a clinically recognizable active pulmonary lesion.

The decision to apply surgical treatment is determined in the main by the condition of the underlying lung. In a classification based as primary or secondary, it is difficult to assess with accuracy the amount of lung involvement. The presence of a large pleural effusion, whether seropurulent or purulent, makes X-ray diagnosis of the pulmonary lesion often impossible. Tuberculosis limited to the pleura is generally accepted as being of rare occurrence and one must also remember that an extension of a tuberculous lesion in the lung may occur subsequent to the development of the empyema.

Archibald recognizes a seropurulent and purulent form of the tuberculous type. While the degree of infection is of much importance in that the purulent is invariably a further stage of the seropurulent form, denoting also in some cases a more serious infection, the indications for surgical interference remain unaltered.

In the group of tuberculous empyemata with secondary infection, there are present added indications for surgical treatment which do not pertain to the tuberculous group *per se*. These indications may be such as have caused the mixed infection, e.g. bronchial fistula or external drainage, fixation of the cavity due to a greatly thickened pleura, or long standing toxæmia.

## DIFFERENTIATION

It is all important that a tuberculous empyema be differentiated from one of purely pyogenic origin. Seropurulent or purulent fluid aspirated from the chest and found to contain no pyogenic

organisms should be considered tuberculous. The writer has had the experience of one case where the fluid was repeatedly sterile in aerobic culture, but anaerobically gave a pure culture of *Brucella abortus*. This case to his knowledge is the only instance of an empyema resulting from such infection, and, while not of frequent occurrence, with the increasing incidence of undulant fever this possibility must be borne in mind. The diagnosis rests in the examination of the aspirated fluid for tubercle bacilli, guinea pig inoculation or microscopic examination of the excised pleura in patients operated upon. Repeated examination of the fluid as well as animal inoculation may fail to demonstrate tubercle bacilli. One must then rely on other criteria to establish a diagnosis. If there is sufficient evidence to show that an insidiously developing primary pleural effusion preceded the empyema, it should be regarded as tuberculous. This fact is now generally accepted. The finding of tubercle bacilli in the sputum is presumptive evidence that an accompanying empyema is tuberculous. Empyema developing from serous effusions, the result of pneumothorax treatment or in the presence of active pulmonary tuberculosis may also be considered tuberculous. Too much care cannot be taken to establish a proper diagnosis as the entire future treatment depends on so doing.

Several of our cases were admitted after a rib resection with a history somewhat as follows:

Patient is taken ill with infection in the chest and a diagnosis of pneumonia is made. After a variable length of time signs of effusion appear. Apiration is performed and a thin cloudy fluid withdrawn. The temperature remains elevated, the patient is quite ill and the fluid reaccumulates. Aspirations are repeated each time perhaps the fluid is found to be slightly more purulent. No culture is made. The case is considered one of empyema following pneumonia, probably of the influenzal type and a rib resection is performed.

The condition however may be an acute tuberculous infection, with effusion. The rib resection precludes the possibility of a cure by other than prolonged treatment and surgical measures. Whatever chance the patient may have had of overcoming his infection with an expanded lung is denied by the unjustifiable and ill considered external drainage. Alexander says 'the keynote of treatment is that open drainage must never be instituted' and Keller states that over 20 per cent of tuberculous empyema at the Walter Reid



Fig 1

Fig 2

Fig 3

Fig 1 Case 1 A M Condition on admission Acute tuberculous infection with effusion secondarily infected by resection Contralateral lung clear  
Fig 2 Case 1 A M After 6 months' treatment with irrigation No reduction in size of cavity closed stages Small sinus injected with bismuth This later treatment The remaining 12 died

admission, 13 in all, 1 was well after 5 years of The present report includes 6 cases of the severe mixed infection type in which bronchial fistulae were present at time of operation and which were treated by thoracoplasty. These were discharged from hospital with bronchial fistula closed and cavity obliterated. There were 8 with external drainage on admission, all were treated by thoracoplasty. Two patients on discharge had small sinuses, in the remainder complete obliteration of the cavity was obtained. In tuberculous empyema complete re-expansion of the lung may not be possible because of thickened pleura or parenchymal fibrosis, moreover, it may not be desirable on account of the danger of lighting up disease within the lung. Consequently, obliteration of the cavity can be obtained only by some form of surgical collapse, mobilizing the rigid chest wall so that symphyses of pleura becomes possible. In considering the form of collapse, the procedure is determined by the size and extent of the cavity. Decortication of the lung must not be considered because of underlying tuberculous disease. Heddon reported 4 cases in 1922 in which he had performed decortication, the diagnosis being made subsequent to the operation by microscopic examination of the excised pleura. In 3 cases partial obliteration of the cavity resulted, 1 patient died of haemorrhage. The disability resulting from surgical collapse varies with the extent of the operative procedure and resection had been done either before or after empyema, 1 of progressive pulmonary disease. Where bronchial fistula, 13 in all, 10 died, 9 of the empyema, 1 of progressive pulmonary disease. Where

# TREATMENT

Marked absence of agreement seems to prevail as to which cases should be treated conservatively and which should be referred to the surgeon for some form of collapse. In Saskatchewan prior to 1925, all patients were treated by aspiration, with or without air replacement, by injection of anuscripts, and when secondarily infected, by open drainage. Hamilton, of the Saskatchewan Anti-Tuberculosis League, reviewed all cases definitely proved as tuberculous over a period of years and found that in the severe mixed infection type with bronchial fistula, 13 in all, 10 died, 9 of the empyema, 1 of progressive pulmonary disease. Where

resection had been done either before or after empyema, 1 of progressive pulmonary disease. Where bronchial fistula, 13 in all, 10 died, 9 of the empyema, 1 of progressive pulmonary disease. Where



Fig 4

Fig 4 Case 2 M U Shows empyema cavity right side 2½ years after onset Intervening treatment of aspiration and irrigation subsequent to cessation of treatment developed *empyema necessitatis* with anterior sinuses



Fig 5

Fig 5 Case 2 M U Shows size of empyema cavity 9



Fig 6

months after complete posterior thoracoplasty Cavity filled with lipiodol

Fig 6 Case 2 M U Condition on discharge Cavity completely obliterated following unroofing operation on residual cavity

It is considerable where the cavity is large, necessitating a complete thoracoplasty. Vital capacity is lowered. There is the usual operative risk and a certain amount of mutilation and deformity commonly result. The risk is not great, provided graded operations are employed and provided the general condition of the patient is moderately good.

In addition to the usual pre operative preparation, the routine treatment at the Saskatoon Sanatorium, where the cases under review were operated on, is especially directed to minimizing as much as possible pulmonary complications, the result of upper respiratory infections. Some time prior to operation all loose teeth are extracted and carious teeth treated or filled, special attention is paid to pyorrhea and gingivitis. The day preceding operation, a thorough antiseptic toilet of mouth, nose, and throat is carried out by careful cleansing of the teeth, nasal douches, and throat gargles. This is repeated twice on the morning of operation. The same morning the patient is encouraged to empty the lungs of all sputum, first upon awaking and again when the hypodermic is given. In operative chest cases the basal metabolic rate is ascertained and vital capacity estimated. Blood urea is determined, as is also coagulation and bleeding time, and kidney function is appraised by the Mosenthal test. The anesthetic employed has been novocain ½ per cent combined with nitrous oxide gas and oxygen

*a Tuberculous empyema* Where there is little or no evidence of lung involvement and the fluid is seropurulent in character, the treatment is the same as for a purely serous effusion. Aspiration should be resorted to only when pressure symptoms have developed or when the fluid fails to be absorbed after a reasonable period of time. When it is definitely purulent and present in large quantity, early and repeated aspiration seems to give the best results. Hamilton, of the Saskatchewan Anti Tuberculosis League, reports "favorable results from aspiration and irrigation with replacement of air, but that treatment should be early and frequent to prevent serious complications such as bronchial fistula or sinus in the chest wall." If, however, there is much underlying lung involvement, increased pleural thickening, lack of improvement in the patient's condition, or if after repeated aspirations the cavity remains undiminished, thoracoplasty should be considered.

*b Tuberculous empyema with mixed infection* The mildly infected cases, without bronchial fistula or open drainage, should be treated the same as the sterile group. If the toxemia is marked, drainage must be resorted to. If open drainage has been performed, further surgical procedure must be considered just as soon as the patient's condition warrants. If the infection is of long standing, further reduction in the size of the cavity cannot be expected. Six cases in this





Fig 7

Fig 8

Fig 9

Fig 7 Case 3 J S Large empyema cavity on admission  
Fig 8 Case 3 J S Shows size of cavity following posterior extrapleural thoracoplasty

Fig 9 Case 3 J S Shows size of cavity after total costectomy Roentgenogram taken 2 weeks after the fourth stage operation

series were admitted with open drainage and in none was any appreciable diminution in the size of the cavity obtained by irrigation. Occasionally, however, after open drainage and irrigation, the secondary infection is overcome and the sinus closes, with resulting clear, sterile effusion. This occurred in one of our cases. If bronchial fistula develops, open drainage is indicated, to be followed later by surgical collapse. In a case with a long standing bronchial fistula, an attempt was made to obliterate the cavity by thoracoplasty, postural drainage and aspiration before and after operation being depended upon to keep the cavity evacuated. Total thoracoplasty in four stages, preceded by phrenic avulsion, was performed. A residual cavity of some considerable size persisted, requiring drainage, unroofing and muscle transplantation before a final closure was obtained. In such cases open drainage should be instituted prior to or during the first stage of thoracoplasty, through a small dependent opening, well away from the operative field. In the acute stage after drainage, Archibald counsels waiting until the patient shows evidence of overcoming the infection before undertaking further surgical procedure.

The following is a case report of a severe mixed infection, complicating an acute tuberculous effusion.

CASE 1 A M, an English male farmer, aged 24 years, in March, 1930, developed pain in right chest and non-productive cough. He felt feverish but continued to work. Dyspnea developed and he was forced to go to bed 3 weeks.



Fig 10 Case 1 J S Three months later Cavity completely obliterated

after onset with a temperature of 103 degrees. The chest was aspirated and 3,000 cubic centimeters of cloudy fluid was withdrawn. No bacteriological examination of fluid was made. He was admitted to the hospital and ressection was carried out on April 1, 1930. He had lost 15 pounds in weight, night sweats were present and a small amount of sputum. His condition following resection grew worse and he was transferred to the Saskatoon Sanatorium on April 17, 1930, with a temperature of 103.5 degrees, pulse 140, respirations 24-28. On April 19, a further resection was performed to permit of more dependant drainage. Daily irrigations with Dakin's solution were carried out and for several weeks there was no improvement. During this period the temperature varied, 103 to 105 pulse 130 to 160, respirations 24 to 48. Guinea pig inoculation of the chest fluid was positive for tubercle



Fig 11

Fig 11 Case 4 Condition on admission February 1926 Right parenchymatous tuberculosis throughout with cavitation Left lesion in first and second interspaces



Fig 12

Fig 12 Case 4 A B Right empyema with bronchial



Fig 13

Fig 13 Case 4 A B After complete extrapleural thoracoplasty in four stages Left lung unchanged

bacilli. From July to November there was slow but definite improvement but at no time during this period was operative interference considered justifiable. On November 1 phrenic avulsion was performed and on November 20, extrapleural collapse was begun. A total thoracoplasty in four stages was carried out between November 30 1930 and January 10 1931. The serious condition of this patient necessitated long intervals between stages and it is interesting to note that quite definite improvement followed each stage. The contralateral lung remained healthy. The patient continued to improve and was discharged August 12 1931 with a small sinus of 20 cubic centimeters capacity in the region of the drainage wound and without cough or sputum. This man was well and doing light work from the time of discharge to November 31 1931 when he died following an operation for acute intestinal obstruction in his home hospital. (He had had a fecal fistula which necessitated operative closure following an operation for acute appendicitis in June 1909 9 months prior to developing tuberculosis.)

An unroofing operation should not be performed if the cavity is large. Matson reserves this operation for cavities of 150 cubic centimeters or less. Considerable shock accompanies an extensive unroofing operation and the subsequent chest wall protection is poor. This mistake was made in some of our earlier cases.

The severe mixed infection type of tuberculous empyema always presents a grave prognosis. Provided the patient's condition warrants operative interference there should be no delay in instituting surgical measures. Archibald reports 15 cases of this type in which 8 could be treated only by a small rib resection and drainage. These went on to death from progressive tuberculosis, at various intervals, independently of the operation. The 7 remaining were treated by total

fistula  $4\frac{1}{2}$  years after conservative treatment. Left lung now clear.

Fig 13 Case 4 A B After complete extrapleural thoracoplasty in four stages Left lung unchanged

thoracoplasty 2 patients dying in hospital, the 5 remaining were discharged as clinically cured.

## RESULTS

This paper is based on a study of 15 cases definitely proved tuberculous referred for surgical treatment by the medical staff of the Saskatchewan Anti Tuberculosis League during the years 1916 to 1932 inclusive. All cases in this group were of the mixed infection type. There was 1 death a mortality by case of 6.6 per cent. A total of 44 operations were performed the mortality by operation being 2.2 per cent.

The oldest patient was 58 and the youngest 4 the average age being 31 years. There were 13 males and 2 females. The right side was involved 8 times and the left 7. Six cases were complicated by bronchial fistula and 6 were admitted with previous rib resection. 2 had empyema necessitatis. Three showed contralateral lung disease. Amyloid disease was present to a marked degree in one case and moderately so in one other. The average length of time of the duration of the empyema prior to operation was in 14 cases, 3 years and 3 months. The remaining case was a man of 58 who on admission had an empyema evidently of long standing. The history pointed to a bronchial fistula which closed from time to time.

This man was a farmer lived in the open and for years had never consulted a doctor. The only suggestive history of tuberculosis was that 33 years previously at the age of 25 he was confined to bed with what he termed a cold for a period of 2 months with cough and expectoration. Just how long his empyema had existed could not be determined. The patient died the result of pneumonia in



Fig 14 Case 4 A B Two months after thoracoplasty

Fig 15 Case 4 A B Three months after untroofing to drain residual cavity following thoracoplasty

Fig 16 Case 4 A B Complete obliteration following operation. Roentgenogram shows cavity still present in diaphragm and muscle graft to fill cavity is shown in this roentgenogram

the contralateral lung, 17 days after a first stage thoracoplasty. Autopsy showed chronic bilateral pulmonary tuberculosis. This was one of our earlier cases and with present experience would not now be accepted for operation.

Three of the 15 cases were classed as mildly or moderately empyemata. One was a boy, aged 4 years, with a bronchial fistula and in which guinea-pig inoculation was positive. His cavity was obliterated following drainage. This instance is unusual on account of the youth of the patient. The 11 remaining cases were classed as of the severe mixed infection type. In 6 an undecaying operation was performed, in 1 case in one stage and in the remaining 5, in two stages. In these latter the cavities were large and in the light of subsequent experience, extrapleural thoracoplasty would have been a better procedure. Of the 5 remaining cases, 1 was treated by posterior thoracoplasty with undecaying of a residual cavity. In the 4 other cases, a total thoracoplasty was performed. Threnic avulsion preceded thoracoplasty in 4 of the 11 cases. The cause of the mixed infection was rib resection in 6 cases, bronchial fistula in 6 cases, empyema necessitatis, 2 cases, undetermined, 1 case.

Of the 14 cases discharged from hospital, 13 are now living, 1 dying 4 months after discharge, the result of an operation for acute intestinal obstruction. This death cannot be attributed to the chest condition. Three patients have been discharged over 6 years, 2 over 5 years, 3 over 3

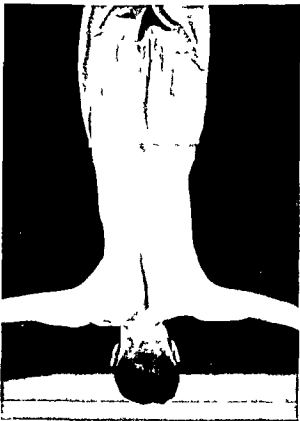


Fig 17 Case 4 B Posterior view, showing full range of movement at shoulder

TABLE I—CAUSES OF SECONDARY INFECTION

	Cases
Rib resection	6
Empyema necessitatis	2
Bronchial fistula	6
Undetermined	1
Total	15

obliterated and in no case has there been a recurrence of cavity formation

The present condition of these patients has been classified as "unimproved," "improved," or "well and working." By "well and working" is meant that a patient is able to do a certain amount of work daily. One patient is unimproved and is now in hospital elsewhere with progressive bilateral pulmonary disease. One patient is improved and one other is too recent to classify. The 10 remaining cases are "well and working." One patient reports he is able to do a full day's work on the farm. The majority of the remainder are capable of doing 4 to 6 hours of work daily. One patient was married at the time of her discharge and is now doing her own housework. This patient showed marked amyloid disease but since discharge has put on 30 pounds in weight. The majority report a certain amount of dyspnoea on exertion, they tire easily but consider themselves in good health. They have been followed closely since discharge and in most instances a yearly examination has been made by a member of the medical staff of the Saskatchewan Anti-Tuberculosis League.

## SUMMARY

1 Adequate study of all patients with empyema should be made before any surgical procedure is performed

2 Sterile purulent effusions should not be drained externally

3 Secondarily infected tuberculous empyemata usually require thoracoplasty

The following additional case histories are illustrative of the type of empyema treated

CASE 2 M U aged 21 years a nurse in training was admitted to Fort Qu Appelle Sanatorium December 6 1926. Family and past history irrelevant. Patient was in good health until November 24 1926. She was in bed 10 days with right pleural onset with temperature. The diagnosis was questionable tuberculosis. December 1 1926. On admission to the sanatorium she had no cough no expectoration. X-ray films suggested spontaneous pneumothorax, right side with effusion (fluid to level of second rib anteriorly). In January 1927 750 cubic centimeters of pus was aspirated the cavity was irrigated with eusol. Aspiration was repeated at approximately weekly intervals and cavity was irrigated. March 1927 pus from chest was positive for tubercle bacilli by guinea pig inoculation. July 1927 sputum 1½ ounce. Aspiration of

TABLE II

	Cases
Died after operation	1
Died since discharge	1
Too soon to classify	1
Unimproved	1
Improved	1
Well and working	10

cavity at weekly intervals was continued followed by irrigation and air replacement. February 1928 she began to run septic type of temperature. May 1928 sputum, 2 ounces. June 1928 empyema necessitatis with spontaneous discharge of 6 ounces pus from chest anteriorly was diagnosed. From June 1928, to May 1929 she had two persistent sinuses in third space anteriorly. When referred for surgical treatment in May, 1929, she showed greatly enlarged liver and spleen. She had septic type of temperature. Her weight was 105 pounds. The contralateral lung was clear. June 24 1929 a rib resection posteriorly was done for dependent drainage of empyema cavity following which sinuses in anterior chest partially closed. Pus in chest again was positive for tubercle bacilli by guinea pig inoculation. Following rib resection the cavity was irrigated daily. The temperature abated but there was no reduction in size of cavity. September 19 1929 a posterior thoracoplasty lower ribs, was done. October 9 1929 a posterior thoracoplasty upper ribs was done. Following total posterior thoracoplasty, a long narrow cavity persisted hourglass in shape with sinuses anteriorly over breast and posteriorly at site of rib resection. April 25 1930 unroofing of cavity, anteriorly, was done. June 17 1930 unroofing of cavity posteriorly was done. This was followed by obliteration of cavity and patient was discharged July 24 1930. June 1931 her weight was 130 pounds. She had no enlargement of liver or spleen. She was well nourished and appeared in best of health. She has married and does 6 to 8 hours housework daily. September 1933 her weight was 135 pounds. She continues to be in good health with no cough no dyspnoea is able to play golf and tennis and swims without difficulty.

CASE 3 J S aged 42 years married laborer-cook normal weight 140 pounds was admitted to Saskatoon Sanatorium September 26 1929. In February 1929 he injured the right chest falling a distance of 20 feet. There was considerable contusion of right chest but no open wound. He ran temperature of 101 degrees. He had a cough with some sputum and considerable dyspnoea. He was in bed 1 week in hospital. The chest was strapped and he returned to work but collapsed the first day at work and returned to the hospital where he remained until April 10 1929 with weakness cough and sputum. His weight was 100 pounds. At this time he had an X-ray of chest and on April 18 1929 the chest was aspirated and thin pus was obtained. No culture was made. No guinea pig inoculation was made. Aspiration was repeated on April 25 and in May 1929 rib resection was done. From May until admission to Saskatoon Sanatorium on September 26 1929 he had a persistently discharging sinus and the cavity was treated by irrigation. On admission sputum was 6 ounces and was positive for tubercle bacilli. There was a free discharge from the sinus. The contralateral lung was good. He was put to bed and given general treatment. The condition improved and the sinus in the chest wall closed. On June 30 1930 aspiration of the chest showed clear fluid. Five hundred cubic centimeters was aspirated and 10 cubic centimeters of 5 per cent gomenol was injected. On July 3 1930 60 cubic centimeters of gomenol was injected. On July 10, 1930 50 cubic centimeters of gomenol

was injected. From July to November, 1930, there was no change in condition. The cavity occupied the whole of the right chest (Fig. 8). Surgical collapse was decided on. Between November 4, 1930, and January 29, 1931, a complete costectomy in four stages preceded by pleuritic avulsion, was performed. The cavity was not drained prior to collapse but as the fluid was clear, the cavity was emptied by aspiration before and subsequent complete obliteration of the cavity was obtained to each stage. Complete obliteration of the cavity was obtained and patient was discharged June 15, 1931. 4½ months following last operation. The weight on discharge was 131 pounds. He had no cough, the sputum was practically nil and negative for tubercle bacilli.

Follow up, February, 1933. Daily sputum 1 ounce, negative for tubercle bacilli. The general health was good but he was dyspnoeic on continued exertion. He could do light work and had a slight morning cough.

Case 4. A B, aged 31 years, laborer, was admitted to Fort Qu'Appelle Sanatorium, February, 1926. The previous history revealed influenza in 1918 when he was in bed 6 weeks. Subsequently he was intermittently well, tired easily. In 1923, he had pain in both chests and developed cough and expectoration. In 1925, cough and sputum became worse. He was tired and weak all the time and began to lose weight. At the end of 1925, he began to lose weight. At the end of 1925, he began to lose weight. At the end of 1925, he began to lose weight.

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considered that the large freely draining fistula would keep the cavity evacuated. This was a mistake, as after completion the thoracoplasty there was a considerable cavity remaining, with sputum 6 to 8 ounces. December 18, 1931, the residual cavity was drained. Following this, the bronchial fistula closed, but the cavity did not decrease in size. March 18, 1932, the cavity was unroofed and soft tissues allowed to fall in, but no healing took place. June 28, 1932, the roof of the cavity was completely excised and the cavity placed in the cavity after debridement of the cavity bed. The muscle transplants were sutured to edges and the skin closed tightly without drainage. Primary healing resulted. Patient was discharged 2 months after last operation. The sputum was reduced to 2 ounces and was negative for tubercle bacilli.

The author wishes to acknowledge his indebtedness to Dr. R. G. Ferguson, director of medical services, Saskatchewan Anti-Tuberculosis League, by whom this material was made available, and to Drs. H. C. Broughton and W. S. Barclay of the Saskatoon Sanatorium for valuable assistance and co-operation in the treatment of these cases.

# UTEROSALPINGOGRAPHY BY INTERRUPTED FRACTIONAL INJECTIONS

## A MODIFIED AND IMPROVED TECHNIQUE<sup>1</sup>

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**D**IAGNOSIS in gynecology is based largely on the fundamental methods of examination in association with microscopic and histopathological studies. In some instances however the usual procedures alone are inadequate to establish a positive diagnosis, and neither the lesion nor its exact location can be definitely recognized. With the development of improved apparatus, radiopaque media and a standardized technique roentgenography has become a valuable diagnostic aid by visualizing previously obscure pathological conditions. The technique of uterosalpingography is simple and does not necessitate hospitalization of the patient, except under unusual circumstances. However its application must be limited to properly selected cases.

Uterosalpingography was originally adapted for visualization of the lumen of the fallopian tubes in cases of sterility. With continued use, its diagnostic and prognostic value has increased to an extent undreamed of by its original advocates.

The accepted procedure is to distend the uterine cavity with one or two injections totaling 8 to 10 cubic centimeters of a radiopaque contrast solution and make X-ray exposures. Another film is taken after an interval of 24 hours. During the course of injection abdominal cramps are not infrequently complained of in some instances so severe as to necessitate discontinuing the injection when only partly completed. The dense shadow cast by the solid column of opaque fluid in the uterine cavity often obscures the presence of small intrusions and irregularities in the contour of the lumen of the uterus and fallopian tubes and filling defects of diagnostic import may not be delineated. The forceful injection of a relatively large amount of contrast solution may result in its entrance into the vascular system. The uterus has no submucosa, on account of the intimate relationship of the mucosa to the underlying plexus of vessels any break in the continuity of the mucous membrane may be accompanied by injury or laceration of the contiguous vessel wall through which the forcibly injected solution may pass into the circulation.

To overcome some of the objections and to eliminate possible sources of error, the method

which is herewith described, and which is based on the following principles, has been developed.

1 Successive injections of 2 cubic centimeters each of the contrast solution are made.

2 The field is exposed to the roentgen ray after each injection and the films are developed immediately.

3 The wet films are inspected to check the technique, so that modifications may be made as are deemed necessary to give maximum diagnostic data.

### PREPARATION OF THE PATIENT

To evacuate the lower bowel a mild laxative is given on the night before examination and a soap suds enema the next morning. The bladder is emptied by voiding or catheterization. The patient is placed on an X-ray table equipped with a Bucky diaphragm, she is placed in the lithotomy position which is maintained throughout the examination. The vulva and vagina are scrubbed with tincture of green soap and water followed by a pitcher douche of oxyganide of mercury 1:2000 at a temperature of 110 degrees F.

### TECHNIQUE

A bivalve speculum fitted with the Hyams diagnostic light carrier is placed in the vagina and the cervix and cervical canal swabbed with a 3½ per cent solution of tincture of iodine. Depending on the position of the uterus and the direction in which the portio points, a tenaculum is placed on the anterior or posterior lip of the cervix. A sterile uterine sound is introduced into the uterine cavity to determine the length and position of the canal. A flexible tipped cannula attached to a Luer syringe is inserted into the uterine canal until the shoulder of the rubber acorn fits snugly into the external os.

With traction on the tenaculum and pressure on the cannula, a small amount of air is introduced into the uterine cavity to ascertain whether or not there is leakage around the acorn. If the cervix is extensively lacerated, precluding a complete closure with the cannula, the anterior and posterior lips may be approximated on each side with a tenaculum to reduce the size of the opening to permit complete occlusion with the cannula, and

<sup>1</sup>From the service of Dr. Walter T. Dannreuther, Department of Gynecology, New York Post Graduate Medical School and Hospital (Columbia University).



Fig. 1 Uterosalphingography by fractional method. First exposure of a series taken October 24, 1932 before treatment, after injection of 2 cubic centimeters of opaque medium. Uterus partially filled.

to prevent leakage into the vagina. If there is no leakage, the instrument is removed and a syringe filled with 10 cubic centimeters of warmed lipiodol is attached to the cannula, and enough solution is forced through to expel the air from the instrument. As soon as the oil appears at the tip, the cannula is reinserted into the uterine cavity and the fractional injections are made.



Fig. 3 Third exposure, same case after third injection of 2 cubic centimeters of fluid, uterus filling fluid is seen entering the tubes.



Fig. 2 Second exposure same case as Figure 1, after injection of additional 2 cubic centimeters. Uterus incompletely filled; fluid has not yet entered fallopian tubes.

The contrast medium is introduced by gradual but steady pressure in five separate injections of 2 cubic centimeters each with an interval between each injection for X ray exposure and immediate development of films. During this brief period between successive exposures, the wet films are inspected for control of errors in technique or to



Fig. 4 Fourth exposure, same case, after fourth injection of 2 cubic centimeters of fluid, uterus and tubes delineated filling defect of uterus.



Fig 5 Fifth exposure same case after a total of 10 cubic centimeters has been injected into uterine cavity note filling defect of uterus tubes well delineated Diagnosis submucous fibroid

elaborate on the procedure if necessary. To preclude leakage the instrument must be held in position during the course of the examination. The entire procedure rarely requires a half hour. The patient is requested to return after 24 hours for a final X-ray exposure. This exposure is



Fig 7 Same case as Figure 1 Diagnosis of submucous fibroid confirmed by diagnostic curettage on October 30 1932 This film was taken 2 months after intra uterine application of radium 600 millicurie hours Irregularity of uterine cavity diminished



Fig 6 Twenty four hour exposure of same case Dissemination of fluid throughout pelvis.

made with the patient in the dorsal posture, with out preliminary preparation and completes the series of six exposures.

Most of the instruments used for insufflation and salpingography have been constructed of rigid metal slightly curved at the distal end and varying in size from No 12 to 20 French. Anatomically, the cervical canal is not uniform in



Fig 8 Same case as in Figure 1 This film was taken 1 year after the application of radium Uterine cavity appears normal patient symptomless





Fig 10 Bicornuate uterus



Fig 9 Congenital anomaly elongation of fallopian tubes

controlled by specific quantities of the medium, physiological distention of the uterus and fallopian tubes is less dangerous and is accompanied or followed by a minimum of reaction. The technique precludes the possibility of uniform results and gives a maximum amount of information. The possibility of such disagreeable sequelae as vascular injection with the media is excluded. Dehiscence of the uterine cavity by this method often differentiates an ovarian cyst from a fibroid protruding into the uterine cavity which might otherwise escape notice. Bicornuate uterus and other congenital uterine or tubal anomalies are clearly outlined in a uterosalpingogram. While congenitally elongated fallopian tubes are uncommon, they do occur and may be the cause of persistent sterility. A young woman presented herself for primary sterility. Repeated transuterine insufflation tests proved the tubes to be patent and a salpingogram confirmed these findings. However, the tubes were found to be tremendously elongated, reaching to within 1 inch of the crest of the ilium. Since the insufflation tests proved that the tubes were open, it was logical to assume that pregnancy could occur, but the salpingogram indicated that while possible, this was extremely improbable (Fig 9).

size, shape, or course, nor is the uterus always in its normal position. In passing a large rigid cannula through the cervical canal into the uterine cavity, considerable trauma may result because of the disproportion between the size of the lumen of which may be distorted by congenital abnormalities or by trauma. The same principles apply also to the internal os and corpus uteri. To overcome these difficulties, I have devised a flexible tip for the cannula to take the place of the rigid end. The advantage of this method of interrupted fractional injections is the complete absence of cramp-like pains or unpleasant sensations in the lower pelvis so frequently associated with the injection of the large amount of fluid into the uterine cavity at one time. The patient is comfortable and completely relaxed, she is able to remain motionless and to co-operate, all of which helps to facilitate the making of good X-ray exposures. This method of injection permits following the progress of the solution as it fills the uterus and fallopian tubes, filling defects and pathological changes are more accurately visualized and located. In view of the fact that the injections are

The instrument embodying this improved flexible tip feature was described in detail in the Nov. 5 Obst and Gynec May 1951

Although skiographic delineation of the uterus and fallopian tubes has been used in the diagnosis of early pregnancy, and despite the fact that abortion has seldom followed, its use for this purpose cannot be recommended. The Aschheim Zondek test and its modifications have proved more reliable than all others for this purpose. I must confess to having inadvertently made salpingograms during the first month of pregnancy in two cases, unaware of the presence of a gestation sac. In neither case was the pregnancy interrupted by the incidental manipulations, both patients going to term and having normal deliveries.

A hydrosalpinx manifesting no gross enlargement on palpation can be demonstrated by salpingography, and an unsuspected hematosalpinx or pyosalpinx may be revealed in the same way. Salpingography is also of value in determining the presence or absence of tubes in patients who have had a previous operation on the adnexa but who are uncertain of its nature.

At all times the degree of pressure used to inject the radiopaque medium into the uterine cavity and tubes must be moderate. Excessive distention may result in the rupture of a tube in the presence of an unsuspected tubal disease and for this reason is particularly dangerous in cases of tubal pregnancy.

Röntgenography of the pelvic viscera must be avoided during menstruation and the 5 days before the onset of a flow. The best time is about 7 days after the bleeding has stopped. A suspicion of either uterine or ectopic pregnancy is also a contra indication. It should not be attempted in the presence of active inflammation of the external genitalia, vagina, cervix or adnexa, because it might be responsible for upward extension of an infection. Indiscriminate use of the X ray and opaque medium in gynecological diagnosis must be avoided and the contra indications must be scrupulously observed.

#### SUMMARY AND CONCLUSIONS

- 1 A new method of fractional uterosalpingography is presented.
- 2 It has distinct diagnostic advantages over the accepted methods.
- 3 It is attended by little or no pain and is without danger in properly selected cases.
- 4 By its use, abnormalities or pathological changes, difficult or impossible of interpretation by other methods, can be frequently demonstrated.
- 5 The proper instruments as well as exact and careful technique are necessary to obtain the best films.
- 6 Hospitalization is not necessary except in unusual cases.

## TUBERCULOUS ABSCESSES OF THE BRAIN SECONDARY TO TUBERCULOSIS OF THE CAECUM

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The ascending transverse and descending colon was found to be narrow and spastic. The ascending colon was intefered with by the palpable mass which moved with it upon manipulation. The caecum was filled. The bowel appeared to be pushed to the extreme right. No appendicitis was seen. The blood Wassermann was negative. Urinalysis and examination of the stool were negative. Blood count: hemoglobin 80 per cent, red blood cells 4,480,000, white blood cells 14,400, differential lymphocytes 26 per cent, polymorphonuclears 57 per cent, large lymphocytes 9 per cent, mononuclears 5 per cent, eosinophils 3 per cent. The diagnosis at that time seemed to rest between (a) perityphilitis, (b) Meckel's diverticulum, (c) omental cyst, (d) hydatid cyst, and (e) carcinoma of the caecum. An exploratory laparotomy was recommended but was not carried out.

When first seen by me on October 22, 1933, a different picture presented. There was a large movable tumor in the right lower quadrant of the abdomen which was not painful or tender on pressure but which was now about the size of a man's fist. The patient gave a history also of periodical attacks of partial intestinal obstruction. Recent genological studies following a barium meal test showed a marked filling defect in the region of the caecum. There was a further history of headaches dating back about 4 weeks. The pain was most marked in the right suboccipital region. There had been a great deal of nausea and frequent vomiting. The patient had lost weight. He had been unsteady on his feet and apparently very ataxic. He preferred to lie on the right side, becoming very dizzy if he turned to the left side. One made out no evidence of tuberculous in the chest. The sense of smell was present on the right side but lost on the left side. His discs showed no choking. There was a slight horizontal dyslagmus on looking to the right, none on looking to the left. There was slight weakness of the right lower face. The Romberg symptom and gait could not be tested, but when propped up in bed the patient fell backward and to the right. There were no abnormal reflexes of the Babinski group on either side. No palpable clonus was present. Blood Wassermann was again negative. A spinal fluid examination showed a clear fluid, containing one cell, marked increase in globulin, negative Wassermann. Colloidal gold curve 0000000000.

No tubercle bacilli or other organisms were seen. The presence of an expanding lesion in the right cerebelar lobe was suspected. The question arose as to whether this was secondary to the tumor in the abdomen and an exploratory laparotomy was suggested. On October 28, 1933, the patient was operated upon by Dr. Tashiro. At operation the mass proved to be an extensive tubercular lesion involving a very movable caecum and the adjacent terminal ileum, with regional mesenteric and omental changes. The caecum and lower portion of the ascending colon were quite thickened and moderately indurated as was also a portion of the terminal ileum about 3 inches long. The appendix was retrocedal and bound down in a mass of adhesions. An extensive resection of the caecum and ascending colon as high as the hepatic flexure and also including 6 inches of the terminal ileum was carried out. An isoperistaltic side to side bowel anastomosis was then done, turning the transverse colon to the terminal ileum. The wound was drained with a cigarette mass.

The central nervous system is not infrequently invaded by tuberculosis. This invasion usually occurs as tuberculous meningitis, military tuberculosis, or less frequently as single or multiple tuberculomata. Tubercle or tuberculoma formations may become confluent and involve relatively large areas of the brain, caseation and breaking down of tissue with secondary infection resulting. On the other hand, true tuberculous abscesses of the brain are very rare. Their pathology differs from that of tuberculous abscesses elsewhere in the body in that it does not involve the various stages of granulomatous change to be expected from an infection or organism of this nature. Apparently these abscesses are blood borne infections from a chronic tuberculous process elsewhere in the body. The method of abscess formation resembles that of other cerebral abscesses caused by pyogenic infecting organisms when these are blood-borne. There is probably a primary period of localized cephalitis, a secondary period of softening, and a final period of capsular formation, in the development of a true abscess. The case here reported is of such a type.

## CASE REPORT

*Tuberculosis abscess of the cerebellum and right frontal lobe, complicating a tuberculoma of the caecum, in a Japanese 46 years old*

M. Y., Japanese male, fish merchant, aged 46 years and single, referred by Dr. K. Tashiro, of Los Angeles, on October 23, 1933, for symptoms resembling those of a tumor of the brain. He was born in Japan, coming to this country at the age of 18. He said to have had an attack of acute appendicitis in 1925 for which he was not operated upon. He was a heavy smoker and drinker. There was no history of chronic cough, chills, fever, expectoration, or loss of weight. On May 12, 1932, he was examined by Dr. Walter Wesells of Los Angeles, who obtained a history of slight pain in the abdomen morning and evening. A month prior to Dr. Wesells' examination he had had an attack of colic which lasted 1 day. This was followed by constipation which was relieved by taking some gas powders. There had never been any nausea or vomiting. His physical examination was entirely negative except for 3 dilated teeth, a slightly enlarged heart and a tumor mass in the right lower quadrant. This mass was described as being about the size of a lemon, rather hard, freely movable, smooth, occupying a position 3 centimeters to the right of the umbilicus and extending from the level of the umbilicus downward for 5 centimeters. The right kidney could be felt above and was distinct from the mass. A gastro intestinal study was negative except that

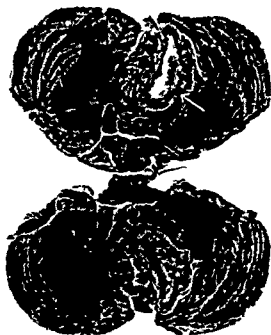


Fig 1: Cerebellum cut in horizontal plane to show tuberculous abscess in cerebellar lobe adjacent to vermis



Fig 2: Coronal section of brain showing tuberculous abscess in right frontal lobe. Note the discrete capsule and absence of gross inflammatory changes about the abscess.

drain and then closed. Following this so far as abdominal symptoms were concerned the patient made an uneventful convalescence. The wound healed *per primam* and free bowel action was re-established.

About a week after this the patient suddenly began to develop signs of meningeal irritation, stiffness of the neck, a positive bilateral Kernig sign and drowsiness. His temperature suddenly arose to 103 degrees. His coma deepened and he died on November 10, 1933. An autopsy of the brain was permitted. Gross and microscopic study of this organ and of the resected cæcum were reported by Dr. C. B. Courville of Los Angeles in part as follows:

**Gross pathology.** The specimen consists of the dura mater covering the dorso-lateral surfaces of the cerebral hemispheres, the entire brain and the cæcum, the latter being a surgical specimen.

**Brain.** The convolutions of the brain over the right hemisphere seemed to be somewhat universally flattened as compared to those of the opposite side. There were no particular areas, however, in which any unusual flattening was observed to point out the location of an underlying lesion. There has been in the recent state a fairly marked cortical congestion and many of the smaller radicals are still visible even after embalming. The arteries are rather thin walled throughout, although their tortuosity especially over the cerebral cortex would suggest that the patient was past middle age. The arachnoid shows considerable minor thickening and opacity in the region of the Sylvian fissure but not to the extent indicative of an inflammatory process.

One rather interesting incidental finding is the extremely small size of the olfactory tracts, which are found as thin string-like structures in the olfactory sulcus. There is a minor grooving of the uncinate region on either side

and extends back, particularly on the left to include a part of the hippocampal gyrus.

There is a bilateral herniation of the cerebellar tonsils about the medulla in the region of the foramen magnum. There is also a marked herniation of the anterior two-thirds of the superior vermis and an adjacent triangular portion of the superior surface of the left cerebellar hemisphere through the tentorium. This herniation is undoubtedly due to the occurrence of a cerebellar lesion to be described later and has taken place caudal to the brain stem.

On the midpoint of the upper surface of the right cerebellar hemisphere adjacent to the vermis there is what appears to be a fluctuant area in this region indicating its presence by loss of cortical markings which measures 1.7 by 2 centimeters in its present state. The folia about this area are likewise considerably flattened and distorted.

The cerebellum was cut in a horizontal section passing through its anterior and posterior margins. This section reveals a fairly large encapsulated abscess in the upper part of the medial portion of the right cerebellar hemisphere extending into the adjacent vermis (Fig. 1). There is apparently the capsule of this abscess observed on the superior surface of the lobe. The abscess in its collapsed state measures 2.1 by 2.7 by 3.2 centimeters in its greatest transverse diameters. There is no evidence of loculation and diverticula from the main abscess cavity. The cavity is lined with a slightly uneven but well defined layer of greenish colored granular pus.

"There is next found a somewhat indistinct connective tissue capsule which varies between one half and one millimeter in thickness. Outside of this a third layer is found consisting of a narrow very well defined zone of reaction which is bright red in color and is evidently accompanied by considerable local congestion. The adjacent brain tissue seems to be remarkably well preserved. There is no evidence of rupture of this abscess. There is however considerable distortion and flattening of the fourth ventricle which is reduced to a mere transverse slit. The dentate



Fig. 3. Resected tuberculous mass including portions of the colon, caecum and appendix. A. The tuberculous mass is indicated by arrows.

*Histopathology.* The following sections were taken from the abscess in the right frontal lobe.

*Section 1, hematoxylin and eosin (Fig. 4).* The abscess wall was characterized by an irregular fibrillar layer of wandering cells whose structure was not clearly made out, suggesting cells whose structure was not clearly made out, and the exudate was examined under higher magnification. The overlying cortex had undergone a minor degree of change. The overlying cortex had undergone a minor degree of change. The overlying cortex had undergone a minor degree of change.

also uninflicted with wandering cells just external to the capsule. There was next a thin wall of connective tissue change. There was next a thin wall of connective tissue change. There was next a thin wall of connective tissue change. There was next a thin wall of connective tissue change. There was next a thin wall of connective tissue change.

*Section 2, stain for tubercle organisms Zeil's method.* Examination of the section under oil immersion reveals a large number of beaded or granular organisms both in the exudate and in the inner portions of the capsule. These disappeared as the outer portion of the capsule was approached, so that none was found in the adjacent brain tissue.

*Gram-Wright stain.* This method was used to determine whether or not other organisms might be present. It showed a number of "beaded" or granular bacilli which Gram positive and were probably tubercle bacilli. Smaller forms which were rounded, resembling diplococci, were also observed, which were probably small forms of the same organisms.

The cerebral hemispheres were sectioned in a coronal fashion, beginning at the frontal lobes and just anterior to the genu of the corpus callosum reveals a slightly irregular contour of the frontal lobe adjacent to the sylvian fissure. It is separated by a narrow zone of white substance 1.5 millimeters in thickness and by a very much attenuated and thinned cortex from the surface of the brain. The abscess cavity measures 2 by 5 by about 2 centimeters (anteroposterior diameter) in its greatest cross sectional diameters (Fig. 2). The central portion of the cavity was filled with liquid, greenish yellow pus, while adjacent to the capsule there was a zone of more solid pus still of greenish color, but probably containing more fibrin. This pyogenic membrane can be separated from the capsule with a little difficulty, showing that organization of this portion had not occurred. The active connective tissue capsule must be very thin, for it was difficult to make out grossly, and probably in no place was it more than one half a millimeter and often much less in thickness. Surrounding the capsule proper there is a brilliant reddish zone, evidently a zone of reaction in the surrounding tissue. This, however, is sharply circumscribed and within a millimeter or two outside this zone there is remarkably little evidence of any disturbance whatever. The white substance of this side shows only slight evidence of edema, as suggested by a slight distortion of the midline structures.

Further sections of the brain further indicate an edema of the right frontoparietal centrum. Both lateral ventricles are dilated, probably due to the occlusion of the fourth ventricle. There is a slight distortion of the ventricular pattern with a minor amount of displacement of the ventricular fluid ventricle is found to be the least marked displacement and is directed toward the left. The posterior horns are markedly dilated, and in this region the ependymal lining shows a number of small discrete petechial hemorrhages. There seems to be no evidence of active inflammation in the ventricle.

Smears from both abscess activities reveal numbers of tubercle bacilli. The colon specimen shows a large irregular yellowish gray mass in the region of the caecum, which has invaded the bowel and caused an irregular ulceration. In this region the wall on cut section is found to be thickened, is very firm, and presents in some areas a whitish fibrous appearance, and in others a cartilaginous structure. In the outer portions of the mass there is more of a cheesy or hyaline structure of the appendix. As near as can be determined from the relationship of the appendix to the entire lower portion of the caecum it seems as though the entire lower portion of the caecum has been involved up to the base of the appendix. The wall of the appendix likewise seems to be thickened, firm and opaque in the upper two thirds of its extent, and on cut section there is a loss of epithelium down to the firm tissue is apparent. A loss of epithelium down to the firm tissue is apparent. A loss of epithelium down to the firm tissue is apparent.

The ulceration within the caecum is very irregular and there is evidence of the inflammatory processes. The abscesses are a sort of gelatinous texture, so that the section in the upper two thirds of its extent, and on cut section there is a loss of epithelium down to the firm tissue is apparent. A loss of epithelium down to the firm tissue is apparent. A loss of epithelium down to the firm tissue is apparent.



Fig 4 Section of wall of frontal lobe abscess showing inflammatory reaction and connective tissue formation of capsule. No tubercles are present. Hematoxylin and eosin method  $\times 80$

**Reticulum stain** This section shows a rather condensed capsule of rather uniform size. There is a slight tendency to a fibrosis of the pyogenic layer, the processes extending from the walls of local blood vessels which at times seem to be increased in number. There is also an evident increase in number of blood vessels in some portions of the brain from which a beginning fibrosis is taking place.



Fig 5 Section of abscess wall right frontal lobe showing numerous tubercle bacilli scattered through the capsule. Ziehl Nielsen method  $\times 900$

**Section 3 Gold sublimate method** This method reveals some tendency to a proliferation of the astrocytes but rather peculiarly at a distance from the wall of the abscess proper. These cells are predominant in a layer just beneath the cortex while the intervening brain tissue between this zone of gliosis and the abscess wall is occupied by a cell which has undergone a degree of regressive change. This differs somewhat from the usual abscess in which an active proliferation of these cells is to be found immediately outside of the connective tissue wall.

**Cajal's reduced silver method** This method reveals nothing further of importance.

**Section from margin of tuberculous mass in caecum** Hematoxylin and eosin (Fig 6) The section is taken from the margin of the mass in the caecum so that normal tissue could be found to compare with the abnormal. This is also taken with the purpose in mind of observing transitional stages of the process. Even in what appears to be normal tissue grossly at the margin of the mass are observed small tubercles of characteristic structure and containing typical giant cells. These tubercles are found predominantly in the submucous but at times are also observed in the muscular coats as well particularly in the superficial portions. In the muscle layer and in the subserous tissues are found collections of lymphocytes with small hemorrhages about the blood vessels. As one approaches the involved area there is a gradual replacement of the normal tissues with tuberculous tissue. The muscle coat is broken up and replaced with fibrous tissue, a reticular tissue or with typical tubercles which may be conglomerate. The subserous and epithelial layers are quite abruptly replaced with tuberculous tissue which at first diffusely invades the normal lymphoid tissue or replaces it with discrete tubercles. The lymphoid tissue becomes less and less conspicuous until finally there remains only small lymphocytic infiltration accompanying the pathological process. The glands seem to terminate quite abruptly for a short space however their remains can be identified by



Fig 6 Numerous conglomerate tubercles shown in submucous coat of caecum. This process is quite different from that shown in the brain abscess of the frontal lobe. Hematoxylin and eosin method  $\times 36$



tubercles or tuberculomata of various sizes. In the center of these masses was an abscess mass  $2\frac{1}{2}$  by 2 by  $1\frac{1}{2}$  inches which contained "yellowish, turbid liquid within ragged cheesy walls." These were in the right frontal lobe. The pathologist reports that the tumors in the boy's brain showed only a few giant cells, the greater part of the mass being without any recognizable structure.

Leontine (1929) reports the case of a 27 year old man with a far advanced pulmonary tuberculosis. The sputum was positive, the lungs extensively involved, a tuberculous coitis was present, and a tuberculous meningitis suspected. At autopsy a tuberculous area in the parietal bone, which had caused extensive erosion, was found. The brain presented a large caseous area of tuberculosis which was apparently not a true abscess although it was so described in the title of the article.

Evans and Smith (1931) reported a case in a 14 year old girl who had an extensive scrofula of the neck of 8 years duration. This patient had daily convulsions of increasing severity for 3 weeks and a terminal hemiplegia. The spinal fluid examination, 2 months before death, showed a clear colorless fluid containing 9 cells—all of which were lymphocytes—trace of albumin and globulin, a negative Kahn reaction, and a delayed positive reaction in testing for sugar by Benedict's method. Bacteriological examination and guinea pig examinations were negative for tubercle bacilli. Another spinal fluid examination 3 weeks before death showed increased pressure, 8 cells positive albumin and globulin, bacteriological examination was negative. Before death the child developed choking of the discs, mental torpor, and incoherence in speech. Autopsy showed a large abscess in the left frontal lobe which contained thick greenish pus, the examination of which revealed "abundant tubercle bacilli with typical morphology." There was no evidence of general meningitis. The pus was stained by Gram's method but no organisms other than tubercle bacilli were found. The region of the abscess was described as follows: "The outer layer of brain tissue showed practically no important changes with the exception of slight oedema. Bordering upon the necrotic area, there was noted a circumferential proliferation of connective tissue cells. There was likewise noted a number of new capillaries lying among the fibroblasts. These young capillaries were congested. The central area was composed of necrotic tissue, leucocytes, and lymphocytes."

Among the cases mentioned, apparently that of Evans and Smith is the only one of an undis-

puted tuberculous abscess. The gross illustration of their case is identical in appearance with ours. The process of formation is apparently the same as that of an ordinary pyogenic abscess. These authors found tubercle bacilli in large numbers in the pus, but did not try to identify them in the abscess wall. Such cases are not necessarily fatal, for Naffziger, has cured one such case by drainage.

#### SUMMARY AND CONCLUSION

A case of multiple tuberculous abscesses of the brain is reported. This is believed to represent a rare type of tuberculous reaction in nerve tissue. The usual granulomatous or tubercle formation is not present. The abscesses apparently are formed as any other pyogenic abscess of blood borne origin are. These tuberculous abscesses, when present, almost invariably accompany some other chronic tuberculous process in the body such as scrofula, tuberculosis of the caecum or tuberculous mastoiditis. In the case here presented typical tubercle formation was present in the caecum, but was absent in the walls of the cerebral abscesses.

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## PARALDEHYDE AS A FACTOR IN PAINLESS LABOR

HAROLD H. ROSENFIELD, M D, and RUBEN B. DAVIDOFF, M D, Boston

- 1 Average duration of primiparous labor was 9 hours and 45 minutes. Average duration of multiparous labor was 5 hours and 40 minutes. Average duration of amnesia and analgesia during primiparous labor was 8 hours and 40 minutes. Average duration of amnesia and analgesia during multiparous labor was 5 hours
- 2 Average duration of amnesia following labor was 7 hours and 30 minutes. Complete amnesia throughout labor was experienced by 285 patients (95 per cent), partial amnesia in 11 cases (3.66 per cent). There were 4 failures (1.33 per cent)
- 3 As to restlessness, 174 patients (58 per cent) showed a mild degree, moving slightly with each pain, 104 patients (34 per cent) showed a moderate degree, turning from side to side and attempting to sit up with pains, and 22 patients (7.33 per cent) showed a marked degree of restlessness, thrashing about, more or less noisy, and requiring added restraint
- 4 There was no maternal mortality. There were 7 still births (2.99 per cent). Of these deaths, 2 were apparently due to a tight cord about each infant's neck. One was due to prematurity, and one was due to a premature separation of the placenta. One showed no possible cause for death. The 2 remaining infants were definitely macerated. Eight babies died during the first week after delivery. Of these there were 3 monstrosities, 1 congenital heart, 2 cases of congenital atelectasis, and 2 cases of erythroblastosis
- 5 Of the babies born alive, 264 (86.54 per cent) breathed or cried readily immediately following delivery, and 34 (11.14 per cent) required mild resuscitation
- 6 Method of deliveries 254 patients were delivered normally or by perineal forceps, and 28 patients were delivered by mid forceps. There were 6 breech extractions and 6 cesarean sections. A Scanzoni maneuver was performed in 3 cases and a similar number were delivered by internal podalic version
- 7 There was no maternal mortality and but one fetal death, a case of congenital monstrosity
- 8 Forty-five babies (90 per cent) breathed or cried readily immediately following delivery and 5 (10 per cent) required mild resuscitation
- 9 In comparison with the results furnished by the trial series, we now give an analysis of the present series of 300 cases

The various methods employed today for providing obstetrical analgesia and amnesia are so well known to obstetricians that we feel even an enumeration of them to be unnecessary here. Suffice it to say that thus far no one method has been found to be applicable to all cases.

The barbiturates form the basis of most of the present day procedures. Sodium isoamylethyl barbiturate (sodium amytal) and pentobarbital sodium (nembutal) are being used, either alone or in combinations with such drugs as morphia, pan topin, scopolamine, or rectal ether. The results measured in terms of amnesia, have been satisfactory with most combinations. But in terms of analgesia there are sufficient disadvantages to each combination. Failure to provide analgesia has resulted in varying degrees of restlessness on the part of the patient ranging from marked excitability to violent resistance, which, although the amnesia was good, the labor not prolonged, and the infants unaffected, has led to questioning the entire desirability of these drugs. On the other hand, where satisfactory analgesia has been obtained, this has been done in some instances, at the expense of the fetus in that varying degrees of asphyxia, ranging from slow breathing to definite respiratory depression, could not be avoided.

The purpose of the procedure used in the series of cases under consideration was to conserve the beneficial effects of the barbiturates in producing satisfactory amnesia and analgesia and also to discover which drug, when used in combination with the barbiturates, would eliminate both the danger of excitation to the mother and the risk of asphyxiation to the fetus. Paraldehyde has been found to satisfy these requirements.

Paraldehyde, according to Cushny, is a polymer of ethylaldehyde. A more powerful narcotic than alcohol it resembles the latter in its effects, but produces only rarely any symptoms of excitement. Even in large doses, it does not affect the heart directly, an important consideration in cases of cardiac disease, and produces no such effects on the protein metabolism as accompany the prolonged administration of chloral. It is observed that the pulse is somewhat slower and the carbonic acid exhaled is less than normal, but these changes are not relatively greater in degree than those that occur in the course of natural sleep and must therefore be ascribed to the lessening of muscular movements. In fact, substantial quantities of paraldehyde have been taken without fatal results or with any more serious consequences than prolonged unconsciousness.

Paraldehyde is excreted in part by the lungs and for the most part in the urine. In this connec-

tion, a recent investigation (4) on the elimination of the barbiturates is of direct interest. It has been found that—

1 Amytal is excreted in the urine of humans and dogs only in traces, if at all, following the administration of its sodium salts.

2 Under the same conditions barbitol and phenobarbital are excreted as such in the urine.

3 Most probably amytal and pentobarbital are rapidly and completely destroyed in the body.

It remains to be stated that paraldehyde, when used alone during labor, even in very large doses, produces neither analgesia nor amnesia, but when applied in combination with the barbiturate group, particularly nembutal, it leads to satisfactory amnesia and analgesia.

The procedure in the present series of 300 cases differs from that used in the preliminary series, in that the alternative use of sodium amytal has been dropped and nembutal has been used entirely because of its more prompt action and because evidence has been found in this series that nembutal, when given early, will not stop labor. Our procedure at present is as follows:

As soon as labor is definitely established, following the routine preparation and enema, the patient is given  $4\frac{1}{2}$  grains of nembutal by mouth. This is followed in 15 minutes by 3 grains more. Now, within 15 to 20 minutes of the second administration of nembutal, the patient is turned on her left side and is given a rectal instillation of 6 drams of paraldehyde in  $1\frac{1}{2}$  ounces of olive oil. This mixture must be instilled high in the rectum, past the presenting part, in order to avoid expulsion during a contraction.

This is facilitated by the use of an apparatus designed and described by McCormick (2). Equally satisfactory results may be obtained by using a 3 ounce glass aseptic syringe with a plunger. A No. 22 F rectal tube is attached to either apparatus. Care must be exercised to insert the rectal tube about 8 inches, without allowing it to curl on itself. If the presenting part is engaged, the tube must be inserted above it.

The mixture is then injected quickly between pains. If the glass syringe is used, a quantity of air should be left in, above the solution, sufficient to insure the emptying of the catheter, but not enough to cause the air to enter the rectum, for this may lead to the expulsion of the solution. Following the injection a pad should be held against the anus for at least 10 minutes.

If the patient is in hard labor, the injection is further facilitated by allowing the patient to inhale nitrous oxide and oxygen until asleep.

Within 3 to 4 minutes from the time of the injection, the odor of paraldehyde becomes perceptible on the breath of the patient and she quickly falls into a deep sleep, moving or turning from side to side during contractions and sleeping soundly in the intervals. The duration of the sleep depends upon the susceptibility of the patient and may vary from 3 to 12 hours. During the first hour after injection labor may become less active in many patients, but following this period labor is spontaneously resumed and appears to progress more rapidly than in those patients who are given no medication. In the majority of cases, with the application of the medication as described, labor progresses to full term and delivery is completed either spontaneously or with the aid of perineal forceps. The average patient in labor will begin to show signs of awakening after a 6 to 12 hour administration. (As a general rule, rectal examinations should not be performed for at least 2 1/2 to 3 hours after the rectal instillation, in order to avoid the expulsion of the stool.) If it were found that the patient still has several hours of labor, 1 1/2 to 3 grains of paraldehyde may be given upon the patient's tongue and by placing the capsule on the patient's tongue and then dropping a small quantity of water in her mouth. As the patient swallows the water she will also swallow the capsule. If this does not succeed or if the patient vomits, remove the powder from the capsule, dissolve in water or in paraldehyde and inject into the rectum. Or, the ends of the capsule may be punctured and inserted directly into the rectum with equal effect. If this dose of paraldehyde may be repeated by rectum. This will usually be sufficient to carry a patient through a 12 hour labor and may be further prolonged, small amounts of paraldehyde, with a 12 to 18 hour interval, may be repeated as necessary.

If the rectal examination reveals that the cervix has been well taken up and four or more fingers dilated, with a low presenting part, instillation of paraldehyde may be considered. For further treatment, the patient should be carried along to completion of labor by means of gas-oxygen inhalations during contractions. It has been found that with the barbiturate group, greater quantities of oxygen are required than in the case with nitrous oxide-oxygen administration. Most frequently equal parts of oxygen and nitrous oxide are required. The duration of administration is required. The duration of administration of gas-oxygen is much less than with the barbiturate-scopolamine group or with straight barbiturates. In addition, patients do not resist inhalation anesthesia, a situation different from that with other drug combinations, where patients become very restless and noisy and violently resist the application of the mask to the face. Under this form of anesthesia, most patients sleep soundly and quietly through labor and move more or less with pains. Furthermore, the most restless of them are rarely noisy, as is the case with the use of scopolamine or of the straight barbiturate group. After a patient has been put to sleep, she should not be questioned by the attendant in order to find out whether or not she is feeling pain. Her reactions, without questioning, are sufficient evidence. Frequently a patient may complain of pain during contractions, immediately fall asleep again in the intervals, and not remember her pains at all.

The question of dosage both of paraldehyde and of membutal is of importance in the trial series we based the amount of paraldehyde on the rectal inspection roughly upon the weight of the patient. At the outset of the series, while an endeavor was made to ascertain the optimum amount of paraldehyde, several patients were given as much as 12 grams and a 12 to 18 hour interval. The dose of membutal varied from 6 to 11 1/2 grams, the latter in divided doses.

In the present series, the dosage of membutal used varied from 6 to 13 grains and that of paraldehyde from 6 to 12 grains. This dosage must be varied according to individual cases, for it has been found that while the initial dose recommended has carried a few cases successfully through 12 hour labors, in some cases it was necessary to repeat as early as 3 hours after the initial dose. There is thus a certain variation of susceptibility, as one might readily expect. The time for repeating the medication must be judged entirely by the reactions of the individual patient and this procedure includes the setting up of any hard and fast rules. Failure to repeat medication when indicated in a given case, regardless of the time element, will give rise to unsatisfactory results, such as increased restlessness and diminished amnesia. For it stands to reason that in inverse ratio to the insufficiency of dosage, restlessness must increase and the possibility is prepared for a greater percentage of failure.

It has been stated earlier that medication is started as soon as labor is established. Our index for onset of labor is the regularity and character of the uterine contractions, regardless of the height of the presenting part or dilatation.

of the cervix Medication is frequently given with a floating presenting part and a cervix which is not taken up

In conclusion, it may be stated that the deductions and experiences drawn from the present series of cases give added force and significance to the advantages observed in connection with the trial series, namely

- 1 Production of prolonged amnesia and analgesia
- 2 Freedom of danger to the mother or the fetus
- 3 Reduction of excitation to a minimum
- 4 Avoidance of delay in labor
- 5 Simplicity of administration

Articles appear from time to time in the lay press making the assertion that painless labor in general is deleterious and is an added factor in increasing maternal and fetal mortality On the contrary, our experience with this method and also the experience of the Boston Lying In Hospital, where experimental series involving most of the methods in vogue today have been carried on, demonstrate that, due to the fact that patients can be allowed to remain in labor without suffering, and with diminution of shock, for longer periods than is ordinarily the case, there is less occasion for instrumentation and a possibility for a greater percentage of normal births This tends to lower morbidity and mortality

Certainly the border line patient can be given a much longer test of labor without discomfort and

shock, and not infrequently she may progress to a normal or easy instrumental delivery from below when otherwise a cesarean section would have been done

In discussing the dangers of anæsthesia during childbirth, one must differentiate between anæsthesia used during actual delivery and drugs given to produce amnesia during labor It is conceivable that a patient may die as a result of inhalation anæsthesia during delivery, when no medication was given to produce amnesia during her entire labor Such a case, classified in the mortality statistics of those who die as a result of anæsthesia used in obstetrics, should by no means be ascribed against painless labor

In a series of over 1,200 cases in which various methods for producing painless labor were used, there is ample evidence to contradict statements which imply that there is prolongation of labor or deleterious effects on mother or baby It must be emphasized that adequate dosage and constant nursing supervision is essential for satisfactory results

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# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY, 1935

### THE BILE ACID FACTOR IN GALL-BLADDER DISEASE

In recent years the progress of gall-bladder studies has been rapid. Knowledge of the methods of formations of various kinds of stones has been put onto firm scientific basis. Cholesterol has been shown to be precipitated when the cystic duct is closed for short periods and the solvent the bile salts, is absorbed. It has been ascertained that long continued cystic duct obstruction leads to the accumulation of calcium either on pre-existing stones or as *Kalkmilchsteine*. Furthermore, the work of many observers has shown that blockage of the cystic duct results in the prompt onset of edema and thickening of the gall bladder with infiltration of its walls by round cells. However, in order to explain the train of events leading to either stone formation or chronic gall-bladder inflammation, a mechanism must be discovered to account for the temporary or permanent closure of the cystic duct. Thus far this has eluded us.

Recent demonstrations of the corrosive action of pure gastric juice suggests an inter-

239

esting parallel. It is true that the gastric secretions *per se* have the power to cause extensive destruction of the mucosa which secreted them why not pay equal respect to bile? This is the strongest solution which the body elaborates. Few people realize that it contains in quantities up to 10 per cent, a substance that is at least as toxic as hydrochloric acid. Bile salts have been shown to have the power to cause a fatal peritonitis, pleuritis, or myositis in lesser concentrations, and their exceeding toxicity for all body cells is well known.

Search for the exciting agent in gall-bladder disease has proved very disappointing. Bacteria are now well known to occur in normal gall bladders in about the quantity and kind as often found in diseased ones. No mechanism of stone formation in open gall bladders is at hand. Closure of the duct by inflammatory edema is a *sine qua non* in each case. The absence of a proper flora has led some to search for a chemical cause. Both pancreatic juice and Dabin's solution are known to be capable of setting up a chemical cholecystitis of a severe type. One wonders why the bile itself which is acidified in the gall bladder to a hydrogen-ion concentration below any other body fluid and whose known toxicity to tissue cells is so high has not been accused of mischief.

Attempts years ago to discover a cholesterol diathesis yielded the surprising result that starvation produced the highest bile cholesterol and that meat or general overeating did not significantly raise the bile cholesterol. The colossal experiment of post-war starvation in Europe produced millions of examples of high-

of the cervix. Medication is frequently given with a floating presenting part and a cervix which is not taken up.

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Certainly the border line patient can be given a much longer test of labor without discomfort and

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grade hypercholesterolaemia, but no increase in gall stones. It is proverbial that gall stones result from overindulgence in rich foods especially meat, and this is known to cause an increase of bile acids in the bile. Thus a paradoxical suggestion seems justified, i.e., that a high concentration of the solvent may provoke an irritation capable of closing the cystic duct and that this, in turn, results in the absorption of the solvent and the precipitation of cholesterol.

Experimental proof of such a hypothesis is wellnigh impossible on account of the fact that any manipulation of the gall bladder of an experimental animal causes the prompt onset of a severe cystitis. We are thus deprived of controls. However, anyone who has once seen the widespread inflammation caused by inserting a sterile needle into a sterile gall bladder, finds it difficult to believe that the inflammation is not a chemical one and due directly to bile itself. EDMUND ANDREWS

#### ACUTE "PEPTIC ULCER" PERFORATIONS—TO DRAIN OR NOT TO DRAIN?

IN order to evaluate this subject properly, both the drainage of the peritoneal cavity and the continuous removal of stomach contents should be carefully considered.

Recently the dictum as regards peritonitis, "When in doubt, drain," seems well on the way to being supplanted by the slogan, "When in doubt, don't drain." It has been known for some time that drainage of acute peritonitis associated with a spreading infection is not as effective as drainage of an abscess associated with a late infection. In fact, as many experimenters have demonstrated, the most that can be proved for drainage of the peritoneal cavity is that it helps localize pus in cases of spreading peritonitis. However, in addition to this change of general surgical opinion as regards

peritonitis, many surgeons apparently have not given consideration to the inhibitory effects of hydrochloric acid on the growth of bacteria in evaluating the question of drainage. Of course, as is well known, bacteria are found low in the intestinal tract more frequently than up higher where the influence of the hydrochloric acid inhibits their growth. In other words, the reaction of the peritoneum following these perforations is due to a chemical rather than a bacterial invasion.

In replies received from over one hundred surgeons, the following information was obtained:

About 20 per cent drain in every case. Most of these employ a drain through a remote incision. About 60 per cent drain only in the late cases, or in cases in which there is evidently definite pus formation. About 20 per cent close the abdominal wall in every case without any drainage. In other words about 80 per cent do not use drainage as a rule.

It is our rule not to employ drainage in these cases, but perhaps our judgment has been somewhat warped by having had the experience of seeing in consultation 4 cases, which had been drained all 4 of which died with duodenal or gastric fistula. In 2 of these 4 cases the drain had been improperly placed to the site of the closure, but in the 2 other cases the drains had been placed remotely—in the flank and in the pelvis, respectively.

Much work has been done on the inhibitory effects of hydrochloric acid. Even in very minute quantities hydrochloric acid has a marked inhibitory effect on the growth of bacteria. This work has been done in the test tube with the bacteria usually found in the mouth and nose, as well as with cultures taken after introduction into the stomach and duodenum.

As a rule, very seldom are bacteria found in the normal stomach. In the stomach with an ulcer having the usual increased hydrochloric



For some years some surgeons have advocated the immediate performance of a gastro-enterostomy following the closure of the perforation. The objectives of this procedure were

1 To make the postoperative discomfort of the patient less by preventing gastric distention

2 To aid in the future care of the ulcer, particularly in those cases which apparently would have a pyloric obstruction from the involution of the ulcer as well as by the scar formation

In recent years the employment of the continuous suction with a small duodenal tube placed through the nose has removed the excuse for doing a gastro-enterostomy for the relief of gastric distention. The use of this tube also removes, more effectively than any other means we have, any retained old blood or other gastric residue

In only about 10 per cent of these cases is it necessary later to do any operative work to effect a cure. This we believe is due to the improved medical care now given by the internist, and even of more value is the fact that the patient who has had the experience of having had a perforation is far more willing to take the medical cure than is the patient with an ulcer who has not had such an education

Resections, or any type of plastic procedures, must necessarily be done with tissue which is infiltrated, and therefore unsatisfactory for suturing. In fact, with desperately ill patients, it is sometimes advisable simply to plug the perforation by suturing omentum into the opening

It is wise for the surgeon to remember that the operation is usually a life-saving attempt and that the patient should not be subjected to any unnecessary procedure

HUGH H. LEVITT

Cultures taken of the peritoneal cavity at the time of these acute perforations seldom show bacteria, and this in spite of the observations contained in a recent article stating that there is no such thing as an "aseptic peritoneal cavity." It might be that the proper cultural methods and media were not employed in making these examinations

Neither bile nor pancreatic juice are well tolerated by the peritoneum, but with these acute perforations, the quantity of either is negligible. It seems to have been proved experimentally that the digestive action of pepsin tends toward the prevention of postoperative adhesions. This is especially true when used in a 0.4 per cent solution of hydrochloric acid

Even inert foreign bodies injected into the peritoneal cavity stimulate first the defensive production of neutrophils and then an increase in the number of histiocytes

After considering all these factors, there is apparently no justification for the institution of drainage of the peritoneal cavity in these cases except possibly in the very late cases showing definite pus formation. Of course, aspiration of the peritoneal cavity should be employed in all these cases while the perforation is being closed, and we all recall numerous cases in which large quantities of gastric contents have been removed, and the abdominal wall closed tightly. A few of the abdominal incisions will break down, but such an occurrence is a minor matter in comparison with a fistula. If the abdominal wall is closed with through and through "tension sutures" of some non-absorbable suture material, infection of the abdominal wall will not be such a serious catastrophe, and this method will also prevent many future ventral hernias



placed by a larger building situated on Craig Street and containing 24 beds, to which the name "Montreal General Hospital" was first given. It was provided with a code of regulations and an attending medical staff, and "one Dr John Stephenson was installed as House-Surgeon, to visit the Hospital every day in case of accidents." From now on events moved quickly. The site of the present Montreal General Hospital was bought by private generosity in August, 1820, and the Government was memorialized for support, on June 6, 1821, the corner-stone was laid, and on May 1, 1822, the central block of the present building, erected by funds obtained from public subscription, was thrown open to patients, with an attending staff of the men already named, and the addition of Henry P. Loedel, who resigned a few months later.

beginning it was clearly formulated that the hospital was to be used as the actual headquarters of a medical school and for the instruction of students, who were to be admitted freely to the wards for teaching and study. That this was understood as far back as 1819 is evident from the discussions in the House of Assembly in that year. Thus Dr Charles Perrault speaking in support of the motion introduced by Mr. Johnson for the establishment of a public hospital in Montreal, said: "Independent of the good which must result

"was continued until the following spring. The first steps in the organization of the Montreal Medical Institution itself were taken on October 20, 1822, when, at a meeting of the medical officers of the hospital held in this capacity," Drs Stephenson and Holmes were deputed "to draw up the considerations that

The following is a brief outline in detail of the sequence of these events:

He died in 1887, and was buried in the cemetery of the Holy Sepulchre, near the city of Jerusalem. His remains were discovered in 1890, and were reburied in the same place. His death was a great loss to the church, and his life was a model for all Christians.

He was a man of great piety and devotion, and his life was a constant study of the Scriptures. He was also a man of great learning, and his knowledge of the Bible was extensive. His writings were of great value to the church, and his life was a constant example to all Christians.

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The following is a brief outline in detail of the sequence of these events

THE RISE OF THE MONTREAL MEDICAL INSTITUTION  
AND THE MEDICAL FACULTY OF MCGILL UNIVERSITY

As indicated previously, this Faculty was the result of three different public movements emanating from the philanthropy and foresight of the English speaking citizens of Montreal in the early years of the last century. These were the foundation of the Montreal General Hospital, the organization of the Montreal Medical Institution, and the establishment by James McGill of his University.

The story goes back to the year 1810. Montreal was at that time a thriving little city of some 20,000 inhabitants, with a rapidly increasing English speaking immigrant population, among whom disease and destitution were distressingly prevalent, and with educational establishments and hospitals dating from the needs of the French Canadian population, for whom also the latter provision was entirely inadequate. In that year the "House of Recovery," a small four roomed cottage which had been opened in the previous year, 1818, by the Female Benevolent Society for

seemed to warrant such an endeavour at this Hospital" This historic document was accordingly submitted a week later and approved Its opening words are of great interest, as are also the references to the Edinburgh School and to the part which the new Institution was to play a few years later in the stabilization of the infant college of James McGill It read in part as follows

The Medical Officers of the Montreal General Hospital, having seen the great difficulties which the student of medicine in this country has to encounter before he acquires a competent knowledge of his profession, knowing the great inconvenience resulting to many from the necessity at present existing of spending several years in a foreign country to complete a regular medical education and being convinced of the advantage which would result from the establishment of a medical school in this country and considering that the Montreal General Hospital affords the student a facility of acquiring a practical knowledge of Physic never before enjoyed in these Provinces an advantage which will be greatly enhanced by the establishment of lectures on the different branches of the profession, have met to consider of the possibility of founding such an institution in this city

They consider that the Montreal General Hospital is an institution which favors much the establishment of a school of medicine in this city—it affords the student a facility of acquiring a practical knowledge of Physic never before enjoyed in this Province—an advantage which will be greatly enhanced by the establishment of lectures on the different branches of the profession

They are further encouraged to attempt the formation of a medical seminary when they reflect that the medical school of Edinburgh the basis of which they would adopt for the present institution now justly considered the first in Europe is of comparatively recent formation it being little more than one hundred years since the medical lectures were first delivered in that city—and the early history of the Royal Infirmary of Edinburgh is not dissimilar to that of the Montreal General Hospital

In the event of the establishment of a classical and philosophical seminary in this city the two institutions would be mutually benefited

To ensure the success and permanency of such an institution it would be highly desirable that the persons composing it should be associated by a Royal Charter or Act of Incorporation

On November 2, 1822, a copy of this Memorandum signed by all five members of the medical board of the hospital was forwarded the governor in chief, Lord Dalhousie, by Dr Robertson with a covering letter in which he suggested that in order to give the new institution legal status, the board of medical examiners for the District of Montreal should be reconstituted and made to consist of the medical officers of the Montreal General Hospital Lord Dalhousie, whose enlightened attitude in educational matters was well known, approved, and on February 22 a Royal Commission was issued appointing "the said Wm Robertson, William Caldwell, John Stephenson, A F Holmes and H P Loedel

any three or more of you to be the sole Medical Examiners for this District"

On February 4, 1823, an advertisement announcing the prospectus of lecture courses for the ensuing session 1823-24 for publication in the newspapers "of the Lower and Upper Canadas," was submitted to His Excellency and duly approved It was headed "The Montreal Medical Institution" and after repeating the introductory paragraphs in the Memorial of Holmes and Stephenson upon the imperative necessity for the establishment of this School, it continued

The circumstances which rendered the success of such an institution probable and the measures intended to be adopted for carrying the same into effect having been submitted to His Excellency the Governor in Chief he was pleased to signify his entire approbation of the plans

"It is therefore resolved to deliver lectures on the following branches of the profession to commence in the second week of November ensuing Anatomy and Physiology J Stephenson M D Chemistry and Pharmacy A F Holmes M D Practice of Physic W Caldwell, M D, Midwifery and Diseases of Women and Children W Robertson M D Materna Medica H P Loedel Esq Surgery J Stephenson M D In the course of the summer 1824 Botany, A F Holmes, M D"

Montreal, 4th February 1823

On August 23, 1823, following, the resignation of Dr Loedel from the Board of the Hospital and Institution was received and Dr Wm Lyons was appointed in his place, a medical library was established, and an announcement of the lecture courses for the session 1823-24 to "commence at the House of the Institution, No 20 St James Street," was ordered published in the Montreal, Quebec, Kingston, and Toronto papers Figure 2 is a photostat copy of this advertisement from the *Quebec Gazette* of October 13, 1823 It effectually settles the date of the first session of the institution

The original minute book of the Montreal Medical Institution containing all its proceedings and copies of correspondence with the Government during the 2 years of its organization has, fortunately for posterity, been preserved in the archives of the Faculty, constituting its greatest treasure These minutes were transcribed in part in an "Introductory Lecture" delivered at the opening of the session 1866-67 by Dr Archibald Hall<sup>1</sup> and they have been published in full by the writer<sup>2</sup> as an appendix to her "Historical

<sup>1</sup>The Past Present and Future of the Faculty of Medicine of McGill University By Archibald Hall M D Edin L R S C E Professor of Midwifery and Diseases of Women McGill University Honorary Fellow of the Obstetric Society of London Associate of the College of Physicians of Philadelphia etc Dawson Bros 1867 also Canada M J 1866-67 3 189-199

<sup>2</sup>An Historical Sketch of the Medical Faculty of McGill University By Maule E Abbott B A, M D Montreal M J, August 1902 pp 351-672 also Gazette Printing Co 111 pages 28 illus Appendix xvi pp 637-665

"The matter of the incorporation of the Medical Institution was dealt with subsequently. In the summer of 1826, at the instance of Lord Dal-

housie, a form of charter was drawn up and pre-

sented through him to the Solicitor-General for

an opinion. The reply, received after a delay of

18 months, was unfavorable, objections being

raised on the ground that the school was not

associated with any seminary of learning, nor

had it any endowment or foundation. After

pleading in vain the similar beginnings of the

College of Surgeons of London, Edinburgh, and

Paris, the officers of the institution suggested to

the Government, as a means of obtaining their

difficulties, "the appointment of the members of

the said Institution as Professors of the Univer-

sity to be established at Burnside, near that city,

one of the Colleges of which is established by

the McGill Charter, dated March 31, 1821, and called

the McGill College." As indicated previously,

this proposal came at the psychological moment

for the young University of James McGill, and

accordingly the memorable step was taken which

gave the Medical Institution a charter and foun-

dation and McGill an active and highly qualified

medical faculty. As a result also the estate of

Burnside was handed over to the university by

the law courts in 1829, but the financial part of

the bequest remained for several years longer in

the possession of the contestant and residuary

widow of James McGill.

*The Medical Institution as a Faculty of McGill*

The first session in which the old medical insti-

tution functioned under its new guise as the

Medical Faculty of McGill University was that

of 1829-30, when it opened with the same teach-

ing staff and some 25 students, its inheritance

from the earlier school. The following year, on

October 29, 1831, a memorial was presented by

its members to the Legislature asking that meas-

ures be taken to give effect to the authority

granted by Royal Charter for the conferring of

degrees to the candidates who had successfully

passed the examinations and fulfilled the require-

ments of this school. On November 7 following,

the Solicitor-General advised that under its chart-

er the university must first secure the royal sanc-

tion of its statutes. Two days later "the stat-

utes, rules, and ordinances of the Medical Faculty

of McGill University" was presented at Quebec

in person by Dr. Stephenson and forwarded to

London. The reply, received on July 23, 1832,

conveyed His Majesty's approval of these stat-

utes and sanctioned the conferring of the title

of "professor" on all four members of the faculty

The first McGill degree was thereupon conferred

on May 24, 1833, in medicine, on Mr. W. Logie

In that year also, the Governors passed a resolu-

tion "that the Medical Faculty be authorized to

use all the means necessary to forward the suit

now pending touching the ten thousand pounds

bequeathed by the Honorable James McGill to

this College," and appointed Dr. John Stephen-

son university registrar. Shortly thereafter, the

money so long withheld, was at last paid over

with accrued interest. It now amounted to

\$22,000. Other changes promptly followed

Edinburgh, which had from the first given official

recognition to the Montreal Medical Institution

by counting two of the latter's courses as equal

to one of her own, now at once, on the joining

of the school to the university in 1829, accepted

the certificates of the faculty at their face value.

The other British schools immediately followed

this lead. Almost from the beginning also the

obligatory course of study was changed to 4 from

3 years, each consisting of a 6 months' session.

THE FOUR FOUNDERS

Before proceeding to later developments a

glance is necessary at the life history of the four

men who figured so largely in the foundation of

this school and university.

*William Robertson (1784-1844)* who was called by his

biographers "the Nestor of the famous quaternet," was

born at Rathoch, Perthshire. He was military service

at a very early age, having been an ensign in a Highland

regiment at the age of 13, and he qualified in medicine at

Edinburgh while still under age. He came to Canada in

1800 and served through the War of 1812, in the capacity

of surgeon to the 41st Regiment, and he was present at the

battle of Queenston Heights and the storming of Fort

Magar. He retired from the army in 1815 and settled

in Montreal and took, as we have already seen, a prominent

part in the epoch making educational developments of the

next 30 years. He was a member of the Board of exam-

iners from 1817 on and was from 1829 the official head of

the Faculty and succeeded Dr. Caldwell in the chair of

medicine in 1833. He led the arduous life of a family

physician with the largest practice in the city, and was dis-

tinguished by his thoroughness and punctuality, generously

shared his charitable character, which made him universally be-

loved.

*William Caldwell (1783-1833)* had been a surgeon in

the 15th Regiment of Dragoons and was a veteran of the

Penninsula War. He was born in Ayrshire and held the

M.D. of Marischal College, Aberdeen University. Returned

to the army after the War of 1812, he took up his

license in the District of Montreal in 1817 and had settled

in that city before 1819. His name is famous locally

because of a duel which he fought in that year as the result

of a quarrel with a Mr. O'Sullivan who had opposed the

petition presented in Parliament by the "Inhabitants of

Quebec" for the abolition of the slave trade.

*William Robertson* By R. F. Rulman McGill University 1902

Montreal' on February 19, 1819, praying for the establishment of an English public hospital. Both participants were wounded but recovered. Dr Caldwell was the first lecturer on the principles of medicine in the McGill School. He served during the great cholera epidemic of 1832 but died of typhus contracted in the wards of the General Hospital in the following year.

Andrew Fernando Holmes (1797-1860) is probably the most outstanding from the scientific standpoint of the four and with Dr Stephenson has been universally considered one of the two real founders of the Faculty. He was born at Cadiz, Spain, where his parents were detained as prisoners of war from a British vessel captured on its way to Canada where they arrived only in 1801. Given a good classical education at Mr Skelton's famous school in Montreal, he was articled at the age of 14 to Dr Daniel Arnoldi. Known at that time as the dean of the profession in Lower Canada. Five years later in 1816 he presented himself for the Licentiate and qualified by examination for the practice of physic as well as surgery. Proceeding immediately thereafter to Edinburgh, he obtained his diploma from the Royal College of Surgeons there in 1818 and in 1819 the degree of M.D. of that university. Along with John Stephenson he studied also in London, Paris and Dublin. In 1818-19 he was made an extraordinary member of the Royal Physical Society and in 1820 a non-resident member of the Wernerian Society of Natural History of Edinburgh. An untiring worker in his profession, he was also an expert botanist and mineralogist and made large collections along both lines which are still housed in the University Museum at McGill. The Holmes Herbarium of Canadian plants, containing 500 species collected by him in the vicinity of Montreal and representing the entire flora of the district. A catalogue of this was published by Dr James Barnston in the *Canadian Naturalist* for 1859. Dr Holmes was also a scientific author of repute and has many articles in British and American as well as local journals, written in a polished style and classical English and based on such accurate and discriminating observation of facts as to make them of permanent value today. His articles on

The Cholera Epidemic as it appeared in Montreal in 1832 and Choleric Diarrhoea published in the *Boston Medical Journal* 1833, 8, 43-45, 236-238 and that on a Unique Form of Cardiac Malformation (still unique in the literature) in the *Transactions of the Edinburgh Medical Association* for 1824 are masterly productions. On his return from Edinburgh Dr Holmes was for 5 years in partnership with his former teacher Dr Arnoldi. At the organization of the Montreal Medical Institution he was appointed lecturer on chemistry and he held this chair until 1843 when he succeeded Dr Robertson as professor of medicine. In 1851 he was elected the first president of the College of Physicians and Surgeons of Lower Canada and in 1854 he became the first dean of the medical faculty of McGill University. He died in harness, when in the middle of calling a meeting for the latter. In 1864 this faculty established the Holmes gold medal which remains today the highest student award within its gift in memory of their late dean "than whom no man ever lived more conscientiously or died more beloved."

John Stephenson (1797-1842). The close friend and life long co-worker of Dr Holmes, and in the words of an eminent contemporary, "the man to whom above all others we owe McGill College" was a native Canadian, having been born in Montreal. He was articled under Dr William Robertson until July 1817, when having finished his apprenticeship he joined Holmes in Edinburgh. He took his degree of M.D. from that University in 1820, having meantime qualified for the license of the Royal

College of Surgeons in London in 1819. On returning to Montreal in 1821 he immediately entered upon a large practice as a surgeon and he lectured on this subject and on anatomy at the medical school from 1823 to 1835 and after this on anatomy alone until his death. As secretary of the medical institution and faculty from their inception and registrar of the university itself from 1833 on, he did devoted service and it was universally recognized by his contemporaries that the successful issue to the university of the contest over the will of James McGill was chiefly if not entirely due to his energy and influence. He was a man of culture and of great industry and integrity and an enthusiast in the cause of medical education. As a surgeon of experience he had the confidence of the public and his name is said to have become in this regard as a household word in the homes of all nationalities in this city.

#### PERIOD OF GROWTH AND DEVELOPMENT

The tragic death of Dr Caldwell from typhus, in 1833, made the first break in the ranks of the four veteran teachers. The gap was temporarily filled by Dr John Racey, and on his removal to Quebec 2 years later, in 1835, by the appointment of G. W. Campbell to the chairs of midwifery and surgery and Archibald Hall to that of materia medica. Both these men were graduates of Scottish Universities, Dr Campbell of Glasgow, and Archibald Hall in M.D. of Edinburgh, and their activities in the succeeding 30 odd years were probably the most essential factors in the rapid expansion and stabilization of the medical school that now ensued, and in the organization of the Canadian medical profession on a conservative educational basis. Dr Campbell held both his chairs until 1842 and then resigned from midwifery but retained that of surgery, which he filled until 1875, a period of 40 years. As a member also of the visiting staff of the Montreal General Hospital during this entire time, he is said to have laid the foundation, by his great skill and distinguished abilities, of the high reputation enjoyed by this hospital as a school of practical surgery. In 1860 he succeeded Dr Holmes as Dean, an office he retained until his death. Dr Archibald Hall (1812-1868) was likewise transferred in the reorganization of the faculty that took place in 1842 on the death of Dr Stephenson and the retirement of Dr William Robertson to the chair of chemistry and in 1854 he succeeded, on the death of Dr McCulloch, to that of midwifery, a position to which he had been specially trained, having served his apprenticeship under Dr William Robertson, the most accomplished accoucheur of his day. Dr Hall's most important contribution lay, however, in the field of medical legislation and Canadian medical journalism of

<sup>1</sup>See the charming article entitled "Reminiscences of the Medical School of McGill University" with a slight sketch individually of the members of the Medical Faculty of 1842 to 1875 by D. C. MacCallum. M.D., M.R.C.S. Eng. *McGill University Magazine* 1903, 3, 124-135.



Dr William Robertson, 1784-1844, official head of the Faculty (1829 and first professor of medicine



John Stephenson, M.D., F.R.C.S., 1797-1842, first registrar of the faculty and university



Andrew F. Holmes, M.D., LL.D., 1797-1860, official head of the faculty from 1844 and first dean (1854-1860)

*William Robertson*  
*John Stephenson*  
*Andrew F. Holmes*

confer degrees)

Fig 1 Portraits of three of the four founders of the Montreal Medical Institution and medical faculty of McGill University, from oil paintings in the possession of the McGill medical faculty, and signatures of the four founders of the medical faculty W Caldwell M.D (1782-1833), A F Holmes, M.D., John Stephenson, M.D., and W Robertson (From their Memorial dated October 29, 1831, praying that the governors of McGill College be given authority to

which latter he may be said to have been the founder. A keen and incisive writer with a clear sense of educational values and a determined though generous opponent of what he considered professional irregularities, he took a leading part in the bitter medical polemics of the day that waged, especially in the years 1847-51, about the rights or otherwise of incorporated medical schools to confer diplomas carrying the right to the license to practice without further examination or university degrees. As editor and owner from 1845 on of that grand old periodical the *British American Journal of Medical and Physical Science*, he fought in this and other ways the battle of his college and of the profession at large and became the intrepid defender of the rights on the numbers advanced steadily to 108 students

**MONTREAL MEDICAL INSTITUTION**  
**THE** Lectures will commence at the House of the  
 Institution No. 20 St. James Street, on MONDAY,  
 the 10th of November next  
 Materie Medica and Dietetics, Thursday 11th at 9 A M  
 Wm FLYNNES Esq.  
 Practice of Physic Thursday 11th at 10 A M  
 Wm GILLWILL M D  
 Chemistry and Pharmacology Monday 10th at 11  
 A M J. H. HODGES M D  
 Anatomy and Surgery Monday 10th at 2 P M  
 J. STELLIUSON M D  
 Midwifery and Diseases of Women and Children, Wednesday  
 13th at 5 P M W. W. ROBERTSON Esq.  
 Lectures on Botany will be given by Dr. HOFMEISER, during  
 the Summer  
 A B. Visiting hours at the Montreal General Hospital,  
 Noon — 11th October

Fig. 2 Advertisement from the *Quebec Galette* October  
 13, 1823, announcing the first courses of the Montreal  
 Medical Institution for the ensuing session 1823-24. (The  
 sign 'S' written across this advertisement was inscribed  
 by the publishers of the paper and indicated that the  
 charge for its insertion was one shilling.)

in 1859 60 141 in 1869 70, 160 in 1879 80 261  
 in 1889 90 312 in 1892 93, 401 in 1894 95, and  
 650 in 1902 03. At the present time, under the  
 limitation of the yearly registration to 100 stu-  
 dents the enrollments at the opening of the  
 present session 1934-35 numbered 480.

The decided impetus that thus took place in  
 the middle of the last century may be ascribed  
 to three different causes. First of these was the  
 growing superiority of the clinical teaching con-  
 sequent on the activities of an enlarged and com-  
 petent hospital staff, among whom must be  
 especially mentioned Robert L. Macdonnell, a  
 licentiate of the Royal College of Surgeons of  
 Ireland who though only 5 years on the staff of  
 hospital and college left upon these a lasting im-  
 press. Trained in the distinguished school of  
 clinical medicine of the Meath Hospital in Dub-  
 lin, where he served under the celebrated  
 Graves and Stokes he became deeply imbued  
 with their teachings and added to a familiarity  
 with the current medical literature and an inti-  
 mate knowledge of the methods of investigating  
 disease, a valuable practical experience gained in  
 their wards as an assistant of these great clin-  
 cians. On his appointment to the staff of McGill in  
 1845, he immediately set about introducing their  
 methods at the Montreal General Hospital with  
 a contagious enthusiasm that quickly resulted in  
 the reorganization on a permanent basis of the  
 teaching in clinical medicine along lines that  
 placed the McGill School on a plane with the  
 most advanced European and American institu-  
 tions. Other factors of importance in the acquir-  
 ing of this reputation were the eminence already  
 referred to above, of G. W. Campbell as a teacher

skilled in the practice of surgery, of Drs. James  
 Crawford and Sewell in clinical medicine, as also  
 the brilliant William Sutherland, and last but not  
 least the sterling qualities of Dr. Michael McCul-  
 loch of Glasgow, an L.R.C.P. of London and an  
 honorary M.D. of McGill, who was professor of  
 midwifery from 1842-54, and who in those pre-  
 auspicious days was yet able to reduce the mortality  
 at the Montreal Maternity Hospital to 1 death  
 in 354 cases.

No less important was the emergence at this  
 time of the University itself from the depression  
 that had until then engulfed it, to an era of rela-  
 tive prosperity and financial security under the  
 powerful administration of McGill's first great  
 principal, Sir William Dawson, whose appoint-  
 ment dates from October, 1855. From the first  
 he took a highly constructive interest in the  
 medical faculty. The appreciation with which  
 he viewed its pioneer labors was expressed in his  
 inaugural discourse at this time as follows:

It is second to none in America and presents one of  
 the noblest instances anywhere to be found of the results  
 which may be attained by the almost unaided exertions  
 of able men thoroughly devoted to their work. Its an-  
 nouncement for the present session (1855-56) shows a  
 staff of 11 Professors, a library of 2,200 volumes, an ex-  
 tensive series of Museum preparations, and excellent  
 arrangements for hospital practice and dissection. It has  
 sent forth since the conferring of its first degree in 1833,  
 150 graduates. Nothing in connection with education in  
 this city offers more just cause of pride or hope for the  
 prosperity of our Institution than the success which has  
 attended the labours of the Medical Faculty.

The third element in the expansion of the  
 Faculty which began with the sixth decade of the  
 last century and has never ceased up to the  
 present time, is described in some detail below.  
 It was the removal of the school to a more con-  
 venient location in the vicinity of the hospital  
 and to the occupation of a building in its own  
 personal possession, the old Cote Street School.

#### THE BUILDINGS OCCUPIED BY THE MCGILL MEDICAL SCHOOL

The first lectures were delivered, as its adver-  
 usements state (Fig. 2), at "the house of the  
 Institute No. 20 St. James Street, a small build-  
 ing (Fig. 3) on the north side of what is now  
 Place d'Armes Square. The School remained  
 here for some years and then removed to a tall  
 narrow building on Fortification Lane just behind  
 the present Bank of Montreal. Later, some time  
 after 1833, the Faculty established itself in a large  
 three story brick building which is still standing  
 on the west side of St. George Street, three doors  
 above Craig Street. The accommodation here



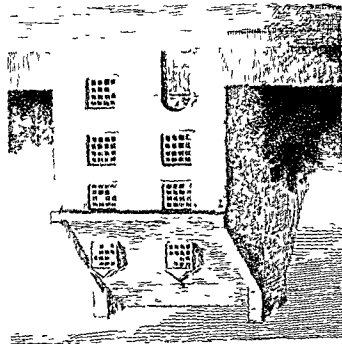
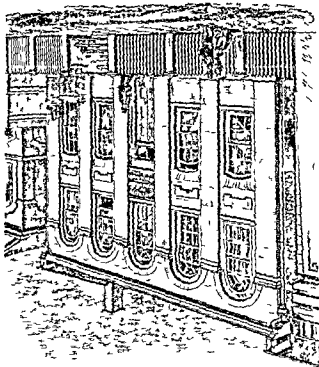


Fig. 3 "No 20 St James Street" believed to be the first home of the Montreal Medical Institution and the medical Faculty of McGill University. (From a drawing by Professor J. C. Simpson, in the possession of the Montreal Medical Museum of the School.)

seems from the first to have been unsatisfactory, but the question of ways and means was at this time of paramount importance. It was probably on this account that the medical faculty was invited to occupy in the year 1845 the Arts building of the university, itself erected in 1843, and the first session of the medical school in the college building was that of 1845-46, and there it remained for the 5 succeeding years. During this time the student body suffered greatly under the inconvenience of the location, which at that time lay out in the country, for the university grounds were a mile and a half beyond the city limits. A lecture at the college ending at 12 noon, a rush through often untrodden winter snow, and a vain attempt to dine and attend a one o'clock clinic at the Montreal General Hospital, were a daily trial even to the bravest, as also were the eight o'clock morning lectures, to be reached frequently only through almost impassable snow drifts, and the attendance by night in the dissecting room on the top floor of this lonely building which lay far removed from other dwellings and was lighted only by candles. On March 19, 1847, the students set forth these disadvantages in a petition asking that the lectures be again given in town. Action was not taken, however, until the spring of 1851, when the St. Lawrence School of Medicine, a rival institution

Fig. 4 The Cote Street Building, owned by the Faculty of Medicine and occupied by it from 1851 to 1872. It was from this building that William Osler graduated in the spring of the latter year



with headquarters in the city, was organized. The McGill School then decided to leave its out-of-the-way situation and return to town rather than risk competition under such unfavorable circumstances. Three members of the faculty, Drs. Campbell, McCulloch, and Sutcliffe, accordingly undertook to erect a suitable building at the faculty, the rent received to be 10 per cent on their private expense, and to rent this to the students. The lot purchased for the purpose was on the east side of Cote Street in the close vicinity of the Montreal General Hospital, and a brick building, No 15 Cote Street, was promptly erected upon it, in time for the opening of the session 1851-52. Here the school remained until the autumn of 1872, and here during these 21 years, passed in an unbroken circle of steady work and gradual progress, the sure foundations were laid for the latter era of relative prosperity that ensued. Here in 1853 all ten of its lecturers were appointed professors, and here in 1854 Dr. Holmes became its first dean. New appointments were made and new courses opened, examinations divided into primaries and finals, a summer session established and the number of students rose from 64 in 1851-52 to a roll-call of 184 in 1866-67. Here Dr. R. Palmer Howard, professor of medicine and dean of the faculty from 1882 on, by his

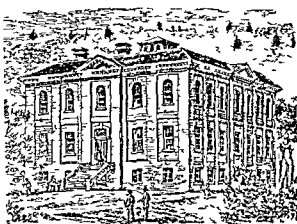


Fig. 5. The first building of the McGill medical faculty in the University grounds. Erected in 1872 and destroyed with its extensions by fire in 1907.

sound and up to date teaching at the bedside in close correlation with the autopsy findings inspired with his own zeal a galaxy of youthful intellects and gave the first impetus to the foundation of a chair of pathology. Here Osler graduated George Ross and Richard L. Macdonnell taught and F. J. Shepherd was an undergraduate—members all of a group of eager young clinicians who were a few years later, to take a leading part in the coming of age of scientific medicine and surgery on this continent.

In the year 1860 the university took over the Cote Street building and made extensive improvements in it at a total outlay of £9,360, of which £1,200 was paid the proprietors for its purchase and the balance expended on the enlargements that had become necessary. The number of students continued to increase steadily however, and again overflowed its capacity so that further space became again essential. And now the faculty themselves began to look upon the university grounds as their proper home. The rapid growth of the city to the westward had removed the old objections to this location, and even rendered it a more suitable spot than a place nearer the hospital, in what promised to become one of its poorer quarters. Accordingly after considerable preliminary negotiation the university decided in the year 1871 to build within its own precincts for the accommodation of its medical faculty. Accordingly a square stone building of commodious proportions was erected by the Governors at a cost of \$27,000 on the University Street side of the college property, and thrown open for occupation in the autumn of 1872 (Fig. 5). Most of the university funds had been de-

rived from the sale of the historic Burnside House, the faculty on its side binding itself to keep the building insured up to \$16,000, and to pay all assessments, taxes, and repairs.

The material advancement of the School after this epoch making step is measured by the extensions of this modest single block of 1872, through three successive additions—that of 1885 for the accommodation of 300 students, that of 1895-96 for the establishment of pathological and public health laboratories to the fine new building of 1902 (Fig. 6). Funds for these operations were obtained from the Lean Choi endowment of \$50,000 given by Lord Strathcona in 1882, and the G. W. Campbell Memorial Fund of \$50,000, raised among graduates and friends of the University in 1883, from \$60,000 contributed by Mr. J. H. R. Molson in 1893 for building and equipment of the laboratories, rendered necessary by the endowment earlier in the same year by Lord Strathcona of the chairs of pathology and public health with \$100,000. In 1899 the same generous donor contributed another \$100,000 and this together with \$3,000 from the faculty funds was all expended upon the construction of the 'new' building or extension of 1901-02.

In 1907 this fine Medical Building, the pride and joy of the Faculty, was destroyed by fire, the only part remaining intact being the extensions for laboratories and lecture room at its rear and the library and historical part of the Museum. In 1911, the present "Strathcona" Medical Building was erected from funds obtained from the fire insurance and \$150,000 from Lord Strathcona, on a site farther up on the hillside commanding a fine view of the city and in closer proximity to the Royal Victoria Hospital, which institution had been founded under the aegis of the university by Lord Strathcona and Lord Mount Stephen in 1894. This 'new Medical Building,' a handsome stone structure of modern construction, was made to house the administration offices, library, and museums, and the departments of anatomy, pathology, pharmacology and public health, the other parts of the school being taken care of in the parts of the older building that had escaped total destruction and which were temporarily repaired for the purpose.

#### THE PRESENT ERA OF EXPANSION

The new building of 1911 was erected and opened under the able administration of Dr. F. J. Shepherd (1851-1929), professor of anatomy for the 30 years from 1883 on, and dean of the faculty from 1908 to 1914, whose eminence both as a surgeon and educationalist were important

factors in the advancement and growing reputation of the school, and were acknowledged by the conferring upon him of the honorary fellowships of the Royal College of Edinburgh and London and the honorary LL.D. of Harvard. This year, 1911, marked also the commencement of what has been termed a golden age for McGill, for, in the 23 years that have elapsed since, an immense expansion has taken place largely in the direction of medical research, the first impetus to which may be said to have been given by the work of Adam (1862-1926). During the last 15 years, that is, since the appointment as principal in the year 1920 of the late General Sir Arthur Currie, with his fine spirit and splendid initiative force, and in 1923, as dean of the faculty, of Dr C. F. Martin whose gift of organization and distinguished services to the cause of medical education were recently recognized by Harvard University by the conferring upon him of its honorary LL.D., this expansion has become nothing short of colossal. So swift indeed has this been alike in new departments organized, in generous benefactions received, and in the appointment of men endowed with the spirit of enquiry and the faculty of leadership, that a mere enumeration of these events is almost beyond the compass of this article. However, the contrast with the day of small things described above is so picturesque and the

outcome of the latter has been so spectacular that an outline must be attempted here

Financial support was supplied in 1911, by the Robert Reford Endowment of \$100,000 for the department of anatomy, and by the establishment of the Arthur A. Browne (\$10,000) and the James Douglas (\$35,000) research fellowships, in 1912, by the gift of \$14,000 for the establishment of the Eddie Morton Laboratory of Pharmacology, in 1913, by the gift of \$12,566 subscribed by the friends and graduates of the medical faculty to meet the fire loss of 1907, in 1917 by the George Ross Endowment Fund, in 1919, by the bequest of Sir William Macdonald of \$500,000 to the funds of the faculty, a year marked also by the invaluable gift of the Osler library, bequeathed to McGill on the death in that year of its beloved owner and founder. In 1921 came the great centenary celebration when \$6,000,000 was given to the University, of which \$4,000,000 was subscribed by the graduates and friends of the Institution, \$1,000,000 was given by the Province of Quebec, and \$1,000,000 was donated from the Rockefeller Foundation, the latter sum being a grant for the special uses of the medical faculty. In 1922 the Biological Building, erected on the site of the original medical building destroyed by fire, was opened, housing the new department of biochemistry in which the researches of Prof J. B. Collip and his associates have brought such

Fig. 6 The New Building of 1902, showing that of 1872 forming its first block, and behind this the extensions made in this and the previous year. The front and middle parts of this building were destroyed by fire in 1907





Fig 7 The Strathcona Medical Building erected in 1911 and in occupation today. Contains the administration offices, medical and Osler libraries and museums and the departments of anatomy, histology and public health.

well deserved fame to the School in 1923, was built the fine Pathological Institute in 1924 the University Clinic for Researches in Internal Medicine was established under the direction of Prof J C Meakins, with the help of a grant from the Rockefeller Foundation of \$500,000 in 1925, came the erection of the Royal Victoria Montreal Maternity Hospital, with accommodation for 200 patients and presenting the last word in equipment under Prof W W Chipman a department of child study was instituted with the help of a grant of \$50,500 from the Laura Spelman Rockefeller Memorial Fund in that year also the departments of public health and preventive medicine were united under the directorship of Prof Grant Fleming, whose wide contacts with every health organization in the city as well as on the National Committee of Mental Hygiene, and as a member of the Advisory Health Board of the city, make this a center of far reaching influence, in 1927, a subdepartment of industrial medicine with an industrial clinic at the Montreal General Hospital was established by a grant from the Metropolitan Life Insurance Company of \$25,000, in 1928, the department of bacteriology was recognized as a separate chair and has acquired in the person of Prof E G D Murray

of Cambridge an occupant of international fame, in 1929, a laboratory for experimental surgery was built and equipped by friends of the Faculty and \$85,000 was donated by the Rockefeller Foundation for surgical researches therein. During 1932-33 an additional \$100,000 was granted from the same source to maintain the research activities of the department of neuro-surgery.

Finally, there has but now come to pass, as the crowning event of the benefactions listed above, in the opening on September 27 last of the Montreal Neurological Institute under the direction of Profs Wilder Penfield and W V Cone, what may well be described as the best and noblest achievement in the history of McGill's great Faculty. Just as, long ago, in the stillness of the committee room of the old Montreal General Hospital, measures were promulgated and activities instituted by public spirited men of vision that gave birth to a great educational movement, so today the hour has once again struck, and opportunity has met, upon its crest, the men Dr Penfield was 'enticed' to McGill in the year 1928, on the initiative of Dr E W Archibald, professor of surgery, under the promise of financial support from a few public spirited citizens and the help of the research funds of the

affair, in affiliation with McGill but independent of it in funds, and functioning for the benefit of the community at large without restriction of place or creed. None who had the privilege of taking part in the great junction of its inauguration, of listening to the first neuro-surgical foundation lecture by Dr Harvey Cushing and the addresses of Drs Gordon Holmes, Martin, Archibald, and others, and Dr Penfield's own clear cut utterances on that occasion, and who had surveyed the perfect adaptation of the building and its contents to the objects in view, can doubt that there is here developed on a sound and enduring basis an international center, in which the study and practice of clinical neurology and neurosurgery, together with scientific investigation in these fields on the highest plane of inquiry, will combine to shed light over this entire continent and to introduce a new era in the understanding and treatment of these most obscure and potentially tragic of all human disorders

faculties, and in company with his devoted associate Dr W V Cone immediately on arrival they organized an effective laboratory service within the necessarily restricted space available, and instituted an extremely active neurosurgical service with headquarters at the Royal Victoria Hospital, but having relations with practically all the hospital units in the city. The creation of the present magnificently equipped neurological institute has been the result of incessant labor of all concerned in the 6 intervening years and was made possible by large endowments for from the Rockefeller Foundation of \$1,232,652, and liberal yearly grants of \$15,000.00 from the City of Montreal and \$20,000.00 from the Province of Quebec as well as munificent gifts from several private donors—Sir Herbert Holt, Mr J W McConnell, Mr Walter Stewart, and four others who wish to remain anonymous. The Institute is thus a civic, national and international

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE monograph on the lymphatics<sup>1</sup> by Drinker and Field, comprises 254 pages of well printed material on pages 5 by 8 inches, bound in rigid covers. The authors state: 'The data presented is drawn from anatomy, physiology, pathology and immunology. We have wanted to give a working idea of what the lymphatics are steadily engaged in doing in the mammalian body.' The first chapter of 12 pages is given to the structure of the lymphatic system and the next section discusses the entrance of foreign particles and colloidal solution into this system. The normal permeability of the blood capillaries and the balance of forces between the capillary blood and the tissue fluid is given considerable space. The authors state that the blood capillaries are the essential mechanism for determining the water content of the tissues. Lymphatic drainage by keeping down the concentration of protein in the tissue fluid affects water absorption but the actual instrument in accomplishing water balance is the blood capillary. The composition and flow of lymph are discussed. One of the principal interests of the authors was the problem of the relation of lymph to the fluid which actually bathes the tissue cells and in which the physiological reactions of the body occur. Capillary lymph and tissue fluid are considered to exist in a common reservoir and to this the blood capillaries make additions of fluid and withdraw it by reabsorption. Experimental and practical considerations comprise the second half of the book. An extensive bibliography and a nice review of the literature is given as the authors cover this subject in a scholarly and conservative manner.

M. H. BARKER

THE *Atlas of Pathological Anatomy*<sup>2</sup> compiled by E. K. Martin, has been issued under the direction of the editorial committee of the *British Journal of Surgery*. This, the first volume, is made up of fasciculi published in the *British Journal of Surgery* during the years 1926 to 1930 inclusive, and is the first of a series of such volumes which are intended to appear from time to time until it includes all such subjects as can profitably be illustrated by drawings of museum specimens without attempting a reproduction of the rarities and curiosities of sur-

gical practice.<sup>3</sup> The late Sir Anthony A. Bowlby, in his introduction to the *Atlas*, has emphasized the fact that illustrations cannot hope to replace the actual examination of specimens, but has expressed the hope that such illustrations will act as a stimulus and guide to the present day surgeon who too often relies entirely upon the opinion of a trained microscopist.

The arrangement of the material within the book is somewhat unusual in that it does not follow the various systems nor the classifications of general pathology. Thus the book starts out with three sections dealing with bone tumors and ends up with a section on inflammation of bone, while between the first three and the last section are sixteen other sections dealing with the stomach, the breast, the kidney and the gall bladder and bile tracts. It is conceivable that if such a lack of arrangement obtains throughout the series the surgeon who has to deal with an obscure bone lesion may have to scan through several volumes before he secures a comprehensive presentation of gross bone pathology. Even in this one volume the comparison of neoplastic with inflammatory bone disease requires turning from one end of the book to the other and still the whole of bone pathology amenable to illustration would not be covered.

The material presented is excellently illustrated and especially pleasing are the numerous colored plates which are beautifully executed and reproduced. The specimens are carefully selected to show the more usual conditions with which the surgeon comes in contact and to depict those stages of the condition which are usually seen by the surgeon. Particularly excellent and especially valuable to the practicing surgeon is the section of 95 pages which deals with diseases of the breast. We find here page after page of illustrations of gross and microscopic appearances of benign and malignant conditions of the breast accompanied by short clinical histories of each specimen.

Each section is headed by a short, succinctly written introduction which covers in a surprisingly thorough fashion the important details of the pathological anatomy and histology.

MICHAEL I. MASON

ABOUT one third of this volume<sup>3</sup> of 400 pages by Pemberton and Osgood is devoted to the influence of the fundamental sciences on our knowledge

<sup>1</sup>LYMPHATICS, LYMPH AND TISSUE FLUID. By Cecil K. Drinker, B.S. M.D. and Madeleine E. Field, A.B. Ph.D. Baltimore: The Williams & Wilkins Co. 1931.

<sup>2</sup>ATLAS OF PATHOLOGICAL ANATOMY. Issued under the direction of the Editorial Committee of the *British Journal of Surgery*. Compiled by E. K. Martin, M.S. F.R.C.S. vol. 1. Baltimore: William Wood & Company, 1931.

<sup>3</sup>THE MEDICAL AND ORTHOPAEDIC MANAGEMENT OF CHRONIC ARTHRITIS. By Ralph Pemberton, M.S., M.D., F.A.C.P., and Robert B. Osgood, A.B., M.D., F.A.C.S. New York: The Macmillan Co. 1934.



as denoting the more inflammatory and the more degenerative forms of Bright's disease, respectively, and as degenerative changes are always present in nephritis, there is no valid objection to looking upon nephrosis as a sub variety of nephritis, the term denoting not cases showing tubular degeneration but rather cases in which inflammatory changes are inconspicuous." It seems to the author wrong to make too sharp a distinction between lipid nephrosis and subacute nephritis since both commonly arise in connection with some septic process in the body. Nephrosis may, therefore be looked upon as a variety of subacute nephritis in which some of the

signs are minimal or lacking. The arterial and sclerotic cases are placed in a group called nephrosclerosis. A small section is given to renal dwarfism and polycystic kidneys. The sections on treatment are concise and they are stated in a practical manner.

This treatise on the whole seems to be a good discussion of medical diseases of the kidney. A broad, constructive viewpoint obtains which gives the feeling that the author has had a substantial experience in the field of renal disease. The sections on treatment are up to date and practical. This little volume should be of assistance both to the student and the practitioner.

M HERBERT BARKER

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**OSTEOMYELITIS ITS PATHOGENESIS SYMPTOMATOLOGY AND TREATMENT** By Abraham O Wilensky A B M D F A C S New York The Macmillan Co 1934.

**THE B C C VACCINE** By K Neville Irvine D M M A B Ch (Oxon) M R C S L R C P London Oxford University Press 1934.

**GYNECOLOGY** By Brooke M Anspach M D 5th ed Completely revised with the assistance of Philip F Williams M D and Lewis C Scheffey M D Philadelphia, London and Montreal J B Lippincott Co 1934.

**LA TROMBOANGIITIS ORLITERANTE** By Dr Julio Diez Buenos Aires 1934.

**CLINICAL PATHOLOGY OF THE JAWS WITH A HISTOLOGIC AND ROENTGEN STUDY OF PRACTICAL CASES** By Kurt H Thoma D M D Springfield Ill and Baltimore Md Charles C Thomas 1934.

**ENDOGENE FAKTOREN IN DER TUMORGENESE UND DER HEUTIGE STAND DER VERSUCHE EINER BIOLOGISCHEN THERAPIE** By Professor Dr G Fichera Berlin Julius Springer 1934.

**PRACTICAL SURGERY OF THE ABDOMINAL AND PELVIC REGIONS** By James William Kennedy M D F A C S 2d ed Philadelphia F A Davis Co 1934.

**THE AUTOCURE DISEASES OR THE RHYTHMIC SYNDROME** By T M Rivers M D Philadelphia Dorrance & Co Inc 1934.

**THE PHYSICAL AND MENTAL GROWTH OF PREMATURELY BORN CHILDREN** By Julius H Hess M D George J Mohr M D and Phyllis F Bartelme Ph D Chicago The University of Chicago Press 1934.

**DISEASES OF WOMEN** By ten teachers. Under the direction of Comyns Berkeley M A M D M C (Cantab) F R C P (Lond.) F R C S (Eng.) M M S A. (Hon) F C O G Edited by Comyns Berkeley J S Fairbairn Clifford White 5th ed Baltimore William Wood and Co 1934.

**AIDS TO OPERATIVE SURGERY** By Cecil P G Wakeley D Sc (Lond.) F R C S (Eng.), F R S (Edin.) 2d ed Baltimore William Wood & Co 1934.

**BENIGN ENCAPSULATED TUMORS IN THE LATERAL VENTRICLES OF THE BRAIN DIAGNOSIS AND TREATMENT** By Walter E Dandy M D Baltimore The Williams & Wilkins Co 1934.

**AIDS TO OBSTETRICS** By Leslie Williams, M D, M S (Lond.) F R C S (Eng.) M C O G 10th ed Baltimore William Wood & Co 1934.

**REVISION ANATOMICA DEL SISTEMA ARTERIAL** Vol. III 2nd part—Atlas Estereoscopico de Anatomia de las Arterias By Pedro Belou Buenos Aires 1934.

**PERIONIC FERTILITY AND STERILITY IN WOMEN** etc. By Professor Hermann Knaus Authorized English translation by D H Kitchin and Kathleen Kitchin, M Sc, M B B S Vienna Wilhelm Maudrich 1934.

**CHEMIOTERAPIA DEL CANCRO** By Prof G Fichera Milan Ulrico Hoepli 1935.

**THE NEW BORN BABY A MANUAL FOR THE USE OF MIDWIVES AND MATERNITY NURSES** By Eric Pritchard M A M D (Oxon) F R C P (Lond) London Henry Kimpton 1934.

**SURGICAL APPLIED ANATOMY** By Sir Frederick Treves Bart. 9th ed revised by C C Choyce C M G, C B E, B Sc N Z M D (Edin) F R C S (Eng) Philadelphia Lea & Febiger 1934.

**SYSTEM OF DIET WRITING** By William S Collins, B S, M D New York Form Publishing Co 1934.

**OUR HERITAGE AND OTHER ADDRESSES** By Colonel the Hon Herbert A Bruce R A M C M D L R C P F R C S (Eng), LL D Toronto The Macmillan Co of Canada Ltd 1934.

**THE 1934 YEAR BOOK OF RADIOLOGY DIAGNOSIS** Edited by Charles A Waters M D THERAPEUTICS Edited by Ira I Kaplan B Sc M D Chicago The Year Book Publishers Inc 1934.

**TREATMENT BY DIET** By Clifford J Barborka B S M S M D D Sc, F A C P Philadelphia London Montreal J B Lippincott Co 1934.

**BODY MECHANICS IN THE STUDY AND TREATMENT OF DISEASE** By Joel E Goldthwait M D LL D Lloyd T Brown M D Long T Swann, M D and John G Kubas M D Philadelphia London J B Lippincott Co 1934.

**TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION** Vol 52 Edited by Walter Estell Lee M D Philadelphia J B Lippincott Co 1934.







*D.B. Greenough*

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME 60 FEBRUARY 15, 1935 NUMBER 2A

## PRINCIPLES OF GASTRIC SURGERY

DONALD C BALFOUR, M.D., F.A.C.S., ROCHESTER, MINNESOTA  
Mayo Clinic

THE American College of Surgeons in this annual lecture keeps before its fellows the life and work of John B. Murphy. Previous lecturers from this country and abroad have rendered tribute to those extraordinary talents through which Murphy attained great eminence and have discussed the contributions through which this master surgeon was such an important factor in elevating American surgery to the position which it has attained. It is, therefore, at once an honor and a responsibility to join in the commemoration of a founder of the College, who created for himself a permanent place in the history of surgery and of surgeons.

The evaluation of Murphy's writings arouses amazement, for it seems inconceivable that with facilities which the surgeon of today would consider meager and inadequate Murphy could have made so many classic contributions which time has confirmed. The surgical treatment of pulmonary tuberculosis, of trigeminal neuralgia, of lesions of bones and joints, of genito-urinary disorders, and of intra-abdominal conditions, particularly acute appendicitis, tuberculosis of the fallopian tubes, and lesions of the gastro-intestinal tract are a few illustrations of the wide interests of his inquiring mind and of the range of his accomplishments.

The progress of surgery since the time of Murphy has been, and will continue to be in specialization, and it is doubtful if any surgeon of his acquaintance would seem appropriate to this occasion.

Inasmuch as not the least notable of the contributions of Murphy are to be found in his published works on diseases of the stomach and duodenum, a brief consideration of the evolution of the principles underlying gastric surgery would seem appropriate to this occasion.

Life of this master surgeon  
ence derived from a contemplation of the will carry on to coming generations the influence, through this memorial lectureship, an inspiration, and the American College of Surgeons, the name of Murphy will always be those who had the privilege of attending his greatest teacher of surgery of his time. To recognize by surgeons of all countries as the to others in a superlative degree and became acquired the art of imparting his knowledge intricate surgical problems of his day. he who have laid the foundation of modern specialization." With his ability to solve the medical practice in all its complexities and who are able to cope with the whole field of the last of a generation of general surgeons. Putt referred to Murphy as "perhaps the most he effected its highest possible development. Putt referred to Murphy as "perhaps the most he effected its highest possible development. Putt referred to Murphy as "perhaps the most he effected its highest possible development."

One of the fathers of modern surgery was Theodor Billroth, of Vienna. His clinic, like Murphy's, became a Mecca for students of his day, and much of the impetus to American surgery can be attributed to Billroth and his school. He was the first to resect the stomach successfully. As Wiese wrote, "There was nothing accidental in its success. Months of hard, persistent study preceded the attempt; the pathology of gastric carcinoma was thoroughly reviewed; statistics were scrutinized from every angle and an entirely new technique had to be devised and practiced." It is interesting to note, as Finney pointed out in a review of the history of gastric surgery, that the great surgeon Langenbeck, only a few years before Billroth performed a resection of the stomach, had said, "I look upon this operation as a quicker method of sending out of this world a man whom it is impossible to save." Contrast this with Billroth's prediction that "every surgeon who has had experience in experiments on animals and similar operations in men has reached the conviction that resection of the stomach must and will succeed." Finney rightly emphasized the part of experimentation on animals in this development since it was the practice of these pioneer surgeons carefully to plan, carry out and study the results of operations on animals before employing them on men. Billroth was a pioneer in surgical pathology and made many contributions in this field, but his greatest legacy was his pupils who were called to fill many of the chairs of surgery not only in Austria, but also in Germany. Murphy always gratefully acknowledged that his methods of clinical investigation were based on what he had observed in Billroth's clinic, and that he owed much of his knowledge of clinical teaching to Professor Albert of Vienna, a contemporary of Billroth.

To the influence of Billroth and his pupils, therefore, may be attributed the progress of gastric surgery and the rapidity of this progress is extraordinary in view of the status of abdominal surgery before this period. The development was characterized by the evolution of technical methods, to the end that operations for lesions of the stomach and duodenum could be safely performed. In this

evolution American surgeons have had a large part. General principles of management soon became established, and various technical procedures were developed to deal effectively with the variabilities of benign and malignant lesions. Attention was directed primarily toward security of suture lines, and to this end attempts were made to eliminate the "fatal suture angle" of the original Billroth I resection (end to end, stomach to duodenum), and to prevent mechanical complications. The problems involved in accomplishing these purposes are evidenced in the many modifications of operations on the outlet of the stomach, of reconstruction operations for gastric resection, and of gastro enterostomy. The history of gastro enterostomy is a conspicuous example of the development of gastric surgery during this early period, for the causes of the mechanical defects which at first almost prohibited performance of the operation, became known and the operation was so modified that now such complications are rarely encountered when the indications for the operation are clear and it is properly performed.

The menace of anastomosis by suture, however, still retarded the advance of gastro intestinal surgery and a variety of mechanical devices such as bone plates were advocated to cope with this danger. None, however, proved satisfactory until Murphy, in 1892, announced the invention of a metal button for accomplishing quick and secure anastomosis between segments of the gastro intestinal tract. This instrument became known as the Murphy button and the evidence soon was conclusive that in respect to safety it was superior to the suture as then employed. This offered a challenge to those who were striving to perfect methods of suture, for the disadvantages of the introduction of a non absorbable foreign body were obvious if some procedure equally safe, and not requiring the use of non absorbable material could be devised. The place of the Murphy button in the evolution of gastro intestinal surgery, especially in those portions of the intestinal tract in which infection is a particular menace, is manifested in the methods still being devised, to what Murphy accomplished with the button, namely, aseptic anastomosis.

resulted in large part from roentgenology, for the film and screen will determine, in 95 per cent of the cases, whether or not a lesion is present, will identify the situation and probably the pathological characteristics of a lesion which is present, will disclose the effects of the lesion on gastric motility, and will give most useful information as to the extent and direction of malignant invasion. Such visualization gives to the clinician opportunities impossible before such methods of examination were developed. It enables him to distinguish more accurately between the functional and organic forms of dyspepsia, and it makes possible that correlation of facts on which the structure of the therapeutics of lesions of the stomach and duodenum must be built.

Surgery of the stomach and duodenum at present, therefore, is based on a foundation of physiological knowledge that has been greatly advanced through experimental and clinical observations, exact pathological classification of lesions, accuracy of diagnosis, better understanding of the indications for operation, more intelligent application of operative procedures, and established principles of technique. As a result, the surgical treatment of lesions of the stomach and duodenum now can be viewed in a broader aspect than ever before.

The urgency of establishing the safety of operation has been reflected in the gradual decrease in mortality and morbidity following operations for lesions of the stomach and duodenum, and large series of cases have been reported from various clinics of the world, in which the mortality of conservative operations for duodenal ulcer is 1 per cent or less, of gastric resection for gastric ulcer 3 or 4 per cent or less, and of resection for gastric cancer less than 10 per cent in general and less than 5 per cent in early cases. Although some of these series may be rightly considered record performances and difficult of duplication, yet they are evidence of the advances which have been made in the safety of operative procedures, when there has been intelligent selection of cases and of operation, adequate preparation of the patient, and the surgeon has the required judgment, skill, and experience.

The primary impetus to gastric surgery, therefore, was the perfecting of technique to a point at which operation could be carried out with minimal risk. The secondary, but no less important, impetus came from the spectacular results following the surgical management of lesions of the stomach and duodenum and of their complications. The revelation that surgical intervention usually could accomplish permanent cure of such a chronic disease as gastric or duodenal ulcer, could cure a definite percentage of cancers of the stomach, could save the life of the patient with an acute perforation, and could permanently relieve benign obstructions, marked one of the great advances of modern medicine. The success with which surgery met such conditions led naturally to efforts to employ surgical treatment in the earlier stages of disease. In the case of ulcer, however, the apparently desirability of earlier surgical management unfortunately led not only to operation being carried out for lesions not suitable for such treatment but not infrequently even led to operation on the stomach before a lesion existed. The practice of earlier operation, however, had far-reaching effects, particularly because actual facts were disclosed, resulting in more exact clinical diagnosis and a better correlation of pathology and symptoms. From a surgical standpoint, the most important result of such practice was to establish a point which I believe is not yet fully appreciated—that while the effectiveness of surgical treatment of gastric cancer increases with the earlier recognition of the disease, the reverse is true of the benign ulcerations of the stomach and duodenum.

The demonstration at operation of lesions of the stomach and duodenum, and the following successes following their surgical management, brought about a vast acquisition of knowledge related to the physiology of digestion and health and disease, of the pathological features of lesions of the various stages, and of the incidence and manifestations of complications. Such advances have

Such examples of the safety of operation on the stomach and duodenum, in respect to both mortality and morbidity, should not give the impression that grave menaces are not always present in such operations. Although it is true that perfected technique has largely eliminated the dangers of serious complications directly attributable to the operations themselves, such as hemorrhage or mechanical defects in the line of suture, other postoperative sequelae equally serious may develop. By far the most important of these are postoperative pulmonary complications which in spite of definite progress in their prevention continue to occur about twice as frequently as they do after operations in the lower part of the abdomen. It is true that although the low mortality of operations on the stomach and duodenum belies the seriousness of pulmonary complications, study will show that at least 50 per cent of the deaths are attributable to them. Since the incidence of these complications is apparently the same whether or not the patient has been anesthetized by inhalation, the primary or major factor contributing to their occurrence is often a mechanical one such as diaphragmatic spasm or unexpelled bronchial secretions. The latter are now considered as the probable precursors of the most common pulmonary complications, namely bronchopneumonia and atelectasis, and the further reduction of the incidence of these complications will depend on the efficacy of methods to prevent accumulation and retention of bronchial secretions.

Now that safety of gastric surgery has reached a point from which it will be difficult to make further advances the question of the efficacy of surgery in the cure or treatment of lesions of the stomach and duodenum becomes paramount for as W. J. Mayo pointed out the time has long since passed when the mere survival of the patient following operation for chronic disease measured the success of the operation. The relative merits of operations, as measured by ultimate results, never can be dissociated from their risk, therefore the basis on which further development will rest must take into account both the risk of operation and the possibilities of cure or palliation. It is from this standpoint that the

present status of surgery for the common lesions of the stomach and duodenum, namely cancer and ulcer, may be briefly discussed.

The surgical treatment of cancer of the stomach in respect to both cure and palliation should be judged not only as to the actual results of such treatment but also in relation to other methods of management of which there is none. Pessimism may be so extreme that the fact that recurrence of the disease can be prevented in a definite percentage of cases following removal of the growth, is disregarded, and the fact is forgotten that nothing other than surgery offers any possibility of complete or permanent relief. Since the only prospect of cure at present lies in extirpation of the growth the problem of management becomes one of recognition of the disease at a time when such treatment can be carried out. It is not to the credit of the medical profession that in only 1 out of 4 cases of cancer of the stomach, when first encountered by the surgeon, can even an attempt be made to cure the patient. At the same time it would be unwise to underestimate the difficulties of early recognition for it is unfortunately true that the majority of cancers of the stomach give rise to slight or even no symptoms in their early stages. It is also true, however, that in the study of any series of cases in which resection is carried out, the average length of time that the patient has been conscious of symptoms has been 11 months. It would seem therefore, that in this lies a challenge to members of the medical profession to convince the public that slight deviations from normal are worth meticulous clinical investigation, and to convince themselves that this investigation should include the only method by which early diagnosis of cancer of the stomach can be made, namely, competent roentgenological examination.

Assuming that the diagnosis has been made sufficiently early, the basis of management of cancer of the stomach is the surgical exploration of all malignant lesions which are apparently confined to the stomach, have not given rise to distant metastasis and do not encroach on or involve the cardiac orifice.

The most effective treatment both in respect to maintaining low mortality and low

With this and a liquid diet of fruit juices, rice water, and so forth, he brought about much amelioration of symptoms. Radiation has been disappointing for any palliative effect. Cancer is the most fatal organic disease of the stomach, but gastric and duodenal ulcer are the most frequent diseases. The chief problem concerning ulcers, which still awaits solution, concerns their cause. Although much contributory evidence has come from clinical and experimental investigation in relation to disturbed function, particularly secretory and motor function, and in relation to infection and to neurogenic factors, evaluation of these continues to be difficult. A lesser problem concerns the indications for, and the merits of, the various operations for gastric and duodenal ulcer. Since, with the realization that it was both impractical and incorrect to attempt to classify gastric or duodenal ulcer as either a medical or a surgical disease, great progress in management came when physicians, roentgenologists, and surgeons co-ordinated their opinions, viewpoints and advice. Perhaps the greatest impetus to such co-ordination can be attributed to roentgenology, which attained such perfection as to remove almost all uncertainty in determining the presence of gastric and duodenal lesions. Nevertheless, from a diagnostic standpoint there is still the pre-operative problem of determining the exact pathological character of the ulcer of the stomach. One of the most valuable advances which could be made would be some method of determining with certainty whether or not such an ulcer were malignant. It is true that the experienced clinician and roentgenologist together, by evaluating every possible sign and symptom, can be reasonably certain of the pathological character of a lesion of the stomach, but there is as yet no absolute evidence, other than that which can be secured by microscopic study of the lesion after removal. Should some method become available to distinguish clinically these lesions, one from another, then ulcer of the stomach could be treated medically without the ever present fear and humiliation of attempting to cure a malignant lesion by diet and alkalies. That a gastric ulcer, primarily benign, may become malignant, is recognized

on the following factors: first, pre-operative overcoming of the effects of dehydration, second, pre-operative cleansing of the stomach by lavage, third, anesthesia adequate to allow satisfactory examination of the growth and possible detection of metastasis, fourth, wide removal of the growth and of a segment of the first portion of the duodenum, together with as nearly complete excipation of lymph nodes, and last, such restoration of gastro-intestinal continuity that the anastomosis not only will function well, but in the event of recurrence of the disease most likely to ensure protection against obstruction of the gastro-intestinal tract. The results of such management have shown that in various consecutive series of cases studied, in which resection has been performed for gastric cancer, the mortality can be 10 per cent or less. The patients alive and apparently well 3 years after operation average 52 per cent in those cases in which the disease was confined to the stomach and 19 per cent in those cases in which lymph nodes were involved. In the cases in which resection was performed with or without lymphatic involvement, 19 per cent of the patients are alive and apparently well at the end of 5 years. Palliation in gastric cancer is an important function of surgical treatment. Removal of the growth has proved to be the most satisfactory procedure, because of the protective and life and protection against distressing symptoms frequently is accomplished. An excellent substitute for removal is complete exclusion by division of the stomach above the growth, closure of the distal segment, and uniting of the jejunum and the proximal segment of the stomach, by the method of DeVane, of Littlebourne. Gastro-enterostomy is usually of little benefit, and should marked or prolonged improvement follow this operation, it would constitute evidence that the growth probably could have been removed. In non-surgical management of inoperable lesions, with obstruction, the value of the stomach tube, as pointed out by Kussmaul in 1869, should not be forgotten. It was the practice of W Mayo for many years to instruct patients in the use of the stomach tube

by all clinicians, roentgenologists, and pathologists, the only difference of opinion is related to the frequency of this complication.

The success of the surgical treatment of both gastric and duodenal ulcer depends largely on selection of those cases for operation in which good results can be expected. This skill in selection is particularly necessary in duodenal ulcer in which variability of symptoms is much greater than in gastric ulcer. The indications for surgical treatment of gastric ulcer are relatively simple, for it is a basic rule that if the ulcer fails to heal, it should be classed as a lesion other than ulcer. Even though symptoms are more or less quiescent, well planned and well performed surgical operation is safer for the patient than harboring a lesion which persists. In duodenal ulcer the general indications for operations are clear when the symptoms become chronic and sufficiently severe, and when such complications as impaired motility, repeated hemorrhage, or acute or chronic perforation have occurred. The mere presence of a duodenal ulcer is by no means a justification for operation.

The general principles of surgical management begin with the premise that the most efficient surgical treatment of gastric and duodenal ulcer is that which will accomplish the best control of the disease with the least possible risk. Consequently, in ulcer the surgeon must be familiar not only with the indications for operation, but also with the details of the technique of the variety of procedures in order to deal with the lesions in their various situations.

In so far as gastric ulcer is concerned, accuracy of diagnosis has made possible its recognition much earlier than formerly, so that in the majority of cases the lesion is still small when operation is carried out. Furthermore, in 90 per cent of the cases the lesion is sufficiently near the angle of the stomach so that its accessibility is not a problem, and any gastritis associated with the lesion is not extensive. Such lesions lend themselves so satisfactorily to local excision, combined with gastro enterostomy, that partial gastrectomy usually seems unnecessary. The results of a well performed excision, either with cautery or knife, combined with gastro enterostomy,

will equal the results of partial gastrectomy in so far as relief of symptoms is concerned, moreover, it has long been known that the danger of jejunal ulcer, when gastro enterostomy is done for a lesion of the stomach, is practically negligible. It is true, however, that from a technical standpoint alone local excision of a large lesion, combined with gastro enterostomy, may be a more formidable procedure than gastric resection. In the high lying large lesions, even radical operation may be unwise, for not only does the sacrifice of healthy stomach seem unreasonable but re establishing gastro intestinal continuity is fraught with much added danger. In such cases, when the lesion is so situated that direct attack on the ulcer is not advisable, healing can be brought about in a certain percentage of the cases by either gastro enterostomy or jejunostomy.

In the treatment of duodenal ulcer there is much discussion as to the relative merits of operations, but it should be realized that no surgeon, regardless of what operation he may favor, applies it in all cases. It is true also that the greater the experience of the surgeon, the more skilled he is in selecting the procedure which will best meet the requirements in each case. The indications for the various procedures, therefore, present a very complicated question, since the age, sex, physical condition, and even the personality of the patient, as well as the variability of the lesion, the known physiological effect of the operation, and the skill of the surgeon must all be taken into consideration. The basis on which the most common operations for duodenal ulcer are carried out can be briefly formulated. The more chronic the lesion and the more motility has been impaired, the clearer is the indication for gastro enterostomy. On the other hand as Ryle pointed out, "no attempt should be made to circumvent mechanically a lesion which is producing no considerable mechanical disturbance of function." Again, the older the patient (which usually implies relatively lower gastric acidity), the more clearly is gastro enterostomy the operation of choice. The contra indications to gastro enterostomy are the indications for those procedures which include removal of the lesion of the duodenum.



surgery but also good judgment was used in selection of the operation

Gastric and duodenal surgery is not static, and to be progressive, surgeons must persistently adjust themselves to the clinical variables of the diseases of the stomach and duodenum, to changing viewpoints as to causes of such lesions, to the difficulties of instituting surgical intervention at the optimal time, to new or revised methods of treatment, both surgical and medical, to shifting concepts of physiological particularly as it applies to restoration of function following various operations, and to the inherent technical problems. The stomach and the first portion of the duodenum are particularly vulnerable to those conditions which may be precursors of chronic disease. One reason for this is that the stomach and first portion of the duodenum, which are derived from the foregut are of later development in embryonic life than is the remainder of the small intestine and the colon and consequently have not acquired maximal immunity. Another reason is that the stomach, since it is insensitive to irritants which in other parts of the body would arouse painful stimuli, is subjected to injury and abuse. This may explain the frequency of lesions of the stomach and duodenum, particularly the frequency of cancer among men. It is such problems as these that have made the developments in the surgery of such a complex field one of the epochs of medical history, and further advances in the surgical treatment of diseases of the stomach and duodenum will always demand adherence to the same precepts and practices as characterized so notably the life of John B. Murphy.

and reconstruction of the outlet of the stomach. The many variations in such direct methods are designed for these purposes, first, to remove as thoroughly as possible the lesion or lesions of the duodenum, second, to provide a satisfactory outlet for the stomach. Partial gastrectomy for duodenal ulcer should, I believe, be reserved for those patients who have had such serious bleeding that thorough removal of the first segment of the duodenum is distinctly to their advantage, and for those patients who are suspected of suffering from a high liability to recurrent ulcer. The most important of all the indications for gastric resection for duodenal ulcer should be that the operation can be done with little more risk than a conservative procedure. It should be remembered, in this connection, that no operation can entirely insure the patient permanently against recurrence.

When surgical treatment is carried out on the basis of chronic, the results will show that in cases of chronic duodenal ulcer in which surgery is clearly indicated, approximately 90 per cent of the patients can be given complete and permanent relief of symptoms and protection against recurrence of the disease. This is a great accomplishment in a disease which has as chronic characteristics as has duodenal ulcer. In a recent article Walton, in reviewing his experience in more than 1,800 operations for chronic ulcer, emphasized the excellent results which can be obtained in duodenal ulcer by use of conservative procedures, one of the most important reasons why such results can be reported is that not only was skill employed in determining the indications for

## INFECTION IN CLEAN OPERATIVE WOUNDS

A NINE YEAR STUDY<sup>1</sup>

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MANY of the details of the sterile technique of surgical operating rooms have been passed on to us by hospital tradition or by word of mouth from our immediate predecessors on the staff. Most of these details we have taken for granted without questioning their rationale. We assume that at some time in the past the reason for this or that step in our procedure was adequately demonstrated. Certain methods are common to all good hospitals. Others have been instituted locally but are not used elsewhere. It is only on such occasions as this when surgeons gather together to discuss their problems and to see 'how the other fellow does it' that we find certain steps in the sterile technique which are different from our own. Then, if we are interested, we question our hosts, or our confreres or ourselves, in an effort to determine which methods are better, theirs or ours. When we ask for proof that a certain step is better we often find that the other fellow has always done it that way but doesn't know why. Consequently, we do not make this change in our own technique. Or worthy changes appear too costly in time or money to warrant their adoption. Often we wait for a catastrophe such as a fatality or a series of deaths or an epidemic in our own hospital to call us to account for our methods. Such an event may disturb our equanimity for a short time and then be forgotten, or it may irritate us to the point of making certain changes, or it may stimulate us to re-survey the whole problem and rationalize the whole procedure weeding out useless steps and adding methods of proved worth in order to bar the way to a future occurrence of the same tragedy. But so often the experience of one individual or one group cannot be passed on to another individual or group. One may be able to profit by his own mistakes but not by those of others or learn from others' experiences.

I must confess that we were going blissfully on our way using operating room technique

handed down for several decades in the firm conviction that it could not be improved upon, and that we were getting excellent results in our wound healing. One day on staff rounds, in the spring of 1925, a clean case was found to have a wound infection. The matter came up for general discussion and the chief of one of the surgical services was asked what percentage of clean wounds he thought became infected. He was an individual extremely careful to be honest and straightforward in his statements. He replied that he thought, if every minor infection were counted, the total might possibly reach 2 per cent. I stated my impression that we were then having more infections than usual and that they might then be in the neighborhood of 5 per cent. I was thereupon assigned the task of finding out what the actual figures were. The records were reviewed from the beginning of 1925. All of the clean cases were listed, together with all of the circumstances of the operation. The dressing notes were scrutinized and any evidence of infection during the process of wound healing was noted.

It soon became evident that not 2 per cent or 5 per cent but about 15 per cent of our clean wounds were becoming infected and that a large number of the serious infections were due to the hemolytic streptococcus. The actual figures were seven and a half times as great as had been suspected by an honest observer. This fact is emphasized because I am sure that impressions are woefully inaccurate in most instances and when you hear any one say that the wound infections in his hospital are negligible, the statement should be discounted, unless there is an actual count and a careful study of the dressing notes. Operators who permit the internes to remove the stitches from their wounds may never know how many of the cases become infected. They have a false sense of security and yet they may conscientiously say that they seldom, if ever, see a clean wound become infected.

<sup>1</sup> From the Surgical Service of the Presbyterian Hospital and the Bacteriological Research Laboratory of the Department of Surgery, College of Physicians & Surgeons, Columbia University. Presented in the symposium on the Treatment of Infections before the Clinical Congress of the American College of Surgeons, Boston, October 15-19, 1934.

operator or his assistants supposedly masked Fifth, they might come from the hands of the operators supposedly sterilized by the process of scrubbing with soap and water and soaking in antiseptics before putting on gown or glove Our chief and immediate concern was to find the source of the hæmolytic streptococcus which caused serious infections in 8 clean cases during the first 5 months of 1925. We cultured every kind of material which had been prepared for the sterile field—those which had been boiled, those which had been autoclaved—those which had been soaked in antiseptic—but found no trace of the hæmolytic streptococcus. The sterile water tanks occasionally contained gram-negative organisms but never a hæmolytic streptococcus. The exposure of blood agar plates to the air of the operating rooms for several hours on many occasions yielded only one colony of hæmolytic streptococcus. Cultures from the skin of the patient seldom gave this organism. It was only when we came to examine the hands and the noses and throats of the operating personnel that we found a field of activity for the hæmolytic streptococcus. Much to our surprise 33 per cent of the operating room staff harbored this organism in the throat and many individuals carried it in the nose as well. This organism could also be recovered occasionally from the hands of the doctors. It was evidently picked up from the dressings and bedclothes of patients suffering from hæmolytic streptococcal lesions and may have been transferred by the doctor to his mouth. Cultures from the hands of the doctors just before dressing these cases seldom yielded these bacteria but directly afterward they were almost invariably present.

*The nose and throat as sources for infecting bacteria.* The above findings suggested the direction for our immediate researches. A survey of noses and throats of the entire operating personnel was made. Fortunately (and I use the word advisedly for I realize how lucky we were), just at that stage of our study a clean hernia developed a hæmolytic streptococcus wound infection. When we looked up the record we found that 3 members of the operating team were carriers of the hæmolytic streptococcus. It had been cultured from the throats of 2 of the doctors and from the nose

Some years ago Brewer shocked the attending staff of a New York hospital when he studied wound infection and found that 30 per cent of the clean cases became infected. By rigid attention to the possible sources of infection this figure was immediately reduced in his hospital. When we found to our dismay that many of our clean wounds were developing infection, we decided to try to discover where the organisms came from and how they gained a foothold in the tissues.

#### THE SOURCE OF THE INFECTING ORGANISMS

The organisms which were cultured from the wounds gave a clue to the sources of contamination. Yellow and white staphylococci were found in the majority of cases. A much smaller number yielded hæmolytic streptococci or non-hæmolytic streptococci. More rarely *Bacillus coli*, *Bacillus subtilis*, *Bacillus pyocyaneus*, *Bacillus proteus*, and diphtheroids were found. The variety of the organisms suggested that the source of these organisms might be various. Every step of the sterile technique was carefully scrutinized to determine, if possible, where the bacteria came from. It was thought, first of all, that they might come from the materials entering the wound, for example, the gauze sponges supposedly sterilized by autoclaving. (Two years ago Dandy maintained that almost every wound infection resulted from contamination from this source and stated that in his institution in the prolongation of the sterilizing process.) Or it was thought that the germs might come from the instruments supposedly sterilized by boiling, or the knife blades and sharp instruments supposedly sterilized by soaking in alcohol, or from the catgut supposedly sterilized by heating, or from the water or saline used during the operation supposedly sterilized in large tanks. Second, it was thought that they might come from the dust particles in the air which dropped upon the sterile field during the course of the operation. Third, they might come from the skin of the patient supposedly sterilized by the patient Fourth, they might come from the nose or throat of the

as well as throat of the instrument nurse, just a few days before the operation. By a strange coincidence also, as it proved, cultures of the patient's nose and throat yielded hæmolytic streptococci. The question arose which of the extraneous strains matched the organism which had been recovered from the wound. By the injection of rabbits with the several strains, agglutinating sera were obtained and then by agglutination and cross absorption of agglutinin tests, it was indisputably shown that the organism from the wound was identical with the organisms from the nose and throat of the instrument nurse and entirely different from the strains from the patient's nose and throat and the strains from the 2 doctors. The evidence was overwhelming that the organism had been discharged from the unmasked nose or throat of the instrument nurse upon the sterile field. Thereupon the order went forth for all operating teams with out exception to mask both nose and mouth with fine meshed 4 ply gauze masks. This measure we found reduced the number of organisms deposited upon a blood agar plate held in front of a person so masked, to approximately the number deposited on a control plate some distance away. This complete masking was later extended to all persons both sterile and unsterile entering the operating room except the patient himself. There upon our hæmolytic streptococcus wound infections were immediately reduced to casual numbers that could probably be accounted for by contamination from other sources.

Reports of this demonstration appeared in the literature (8-9) and individuals here and there profited by our experience, but the matter has not received general recognition although Dr. Stage Davis has recently called attention to it again. I have since seen, and you will see here in Boston, as well as in Chicago, Philadelphia, Baltimore and in my own home town of New York, surgeons who do not mask the nose and who do not know that they are subjecting their patients to an unjustifiable risk from the neglect of this one measure in sterile technique.

Dr. Walker of this city was stimulated by a similar misfortune in his own hospital to study the problem of adequate masking and demon-

strated that the only germ proof mask was one containing an impermeable membrane such as rubber. Its advantage over the 4 ply fine meshed gauze mask is apparent to any one who will take the trouble to blow smoke through these two masks, but the impermeable mask is far from ideal because of its discomfort and the other mask seems to be satisfactory for all practical purposes, for it will stop droplet contamination from both nose and mouth. The anæsthetists objected to masking, because they said it was difficult to breathe when the fumes of the anæsthetic were added to the annoyance of the masks but when they were exempt for a few months 3 cases of hæmolytic streptococcus infection developed following thyroid operations and the proximity of the unmasked anæsthetist in these operations rendered them suspicious sources of these organisms. Now there are *no exceptions* and if any member of the staff is known to have a cold he is either relieved from operating room duty or is required to wear two masks and to double the time for scrubbing and antisepticizing his hands before operation.

We realized, of course, that the noses and throats of the operating personnel were not the only source of the organisms causing wound infections, but this was the most significant finding in our first year's study and the statistics obtained for 1925 served as a basis upon which to measure any improvements in our sterile technique. The 1925 results proved to be of such interest and importance to the staff that it was decided to make it continuous. This has kept every member of the staff alert and "infection conscious" and has made us all strive continuously to improve our record.

*The autoclaved materials as a source of organisms.* We have maintained a continuous check on our autoclaves by inserting in the center of the material a cotton thread saturated with *Bacillus subtilis* spores and then testing for their destruction. In 1929 we changed the test organism to another strain and soon afterward began to obtain, occasionally, positive cultures. No change had been made in the sterilization process but we found that our new test organism would stand boiling for 15 min-

blades with heavy suspensions of mixed bac-  
 teria and subjecting them to contact with  
 these antiseptics for varying lengths of time.  
 We found that the best antiseptic to sterilize  
 and at the same time maintain sharpness was  
 the Bard-Parker germicide. We used that for  
 over a year but finally had to yield to the pro-  
 tests of the nurses who handled those mate-  
 rials, because severe burns of the skin resulted  
 from contact with this germicide or its fumes.  
 Furthermore, a number of severe reactions  
 following spinal anesthesia, with central ner-  
 vous system symptoms and increased cell  
 count in the spinal fluid, were attributed to a  
 small amount of this chemical having re-  
 mained in the needle or syringe at the time of  
 lumbar puncture. Occasionally also, we pro-  
 duced skin necrosis with local anesthetics and  
 the germicide was blamed. Now these instru-  
 ments are either boiled or soaked in pure car-  
 bolic acid for 15 minutes. The Bard-Parker  
 germicide is still being used for the steriliza-  
 tion of the catgut tubes which contain the  
 non-bolable variety of gut.

*Catgut as a source of infecting organisms*  
 Catgut has often been blamed for wound in-  
 fections and there is no doubt that it has been  
 responsible for certain of the cases due to  
 anaerobic spore-forming organisms such as the  
 bacteria. These were more common a genera-  
 tion ago than they are now. Welch once said  
 of the chief reasons why Halsted substituted  
 silk for catgut as suture and ligature material  
 (17) "This point will be mentioned in more  
 detail below. In 1923, before this study be-  
 gan, 2 postoperative infections due to Vibron  
 septicus in the Presbyterian Hospital were  
 directly traced to inadequately sterilized cat-  
 gut. The catgut firm was made liable in a  
 court of law. In 1927, while this study was  
 in progress, the author was asked to see a pa-  
 tient with a postoperative wound infection,  
 in another hospital. The contamination was  
 traced unmistakably to inadequately sterilized  
 catgut sold by another firm. Death occurred in  
 this case and in 4 other similar cases (10).  
 This led to a study of the methods of catgut  
 manufacture and its sterilization as well as  
 tests for its sterility. Several of the catgut

uses. Rather than to change back to a more  
 susceptible test organism we decided to find  
 a way of killing this resistant strain. Our  
 sterilizing time had been 30 minutes at 18  
 pounds pressure preceded by an evacuation of  
 the air just sufficient to reach minus 10 for a  
 few seconds. With this amount of air evacua-  
 tion we found that it took 1½ hours to consis-  
 tently kill our test organism in the center of  
 the central drum, and this period of steriliza-  
 tion frequently scorched the materials and  
 softened the gloves. By prolonging the evacua-  
 tion time at minus 10 to 15 minutes, how-  
 ever, a sterilization time of 30 to 45 minutes  
 was sufficient to kill the spores. Since that  
 time we have followed this procedure and our  
 tests have consistently yielded no growth. But,  
 although Dandy claimed that the autoclaved  
 materials are the sole source of organisms  
 causing wound infections, this change in our  
 own technique has not stopped our wound

*Boiled instruments as a source of infecting organisms*  
 The boiling process for sterilizing  
 instruments has proved to be effective in all  
 of our tests and conscientious timekeepers  
 who wait for the full 5 or 10 minutes  
 should have no fear of presenting unsterile  
 instruments to the operating table. The chief  
 danger from this source occurs when an instru-  
 ment which has been forgotten or one which  
 has been called for in a hurry is rushed through  
 in less than the minimum time. To be sure,  
 some heat resistant spores will withstand boil-  
 ing for 5 minutes but so far as I can ascertain,  
 the only species which may do so are non-  
 pathogenic, such as Bacillus sporogenes and  
 Bacillus subtilis.  
*Instruments "sterilized" in antiseptics as a source of infecting organisms*  
 The sterilization  
 of sharp instruments such as knife blades,  
 scissors and needles, as well as syringes, but-  
 tons, silk worm gut, and catgut tubes has been  
 a real problem. The odor from the apparatus  
 and one fire made us give up the oil steriliza-  
 tion process advocated by Labeay and others.  
 He found that soaking for 15 minutes in 50-  
 70 per cent alcohol (our former method) was  
 entirely inadequate to destroy even the com-  
 monest organisms. We experimented with  
 various antiseptics by contaminating knife

firms followed this study closely and modified their methods according to its findings (11). A standard method of testing for sterility was developed (12). This has been accepted and is now said to be employed by most of the catgut firms. Unfortunately neither the American College of Surgeons nor the American Medical Association has been willing or financially able to set up a laboratory control for determining by periodic tests of specimens of catgut purchased on the open market whether or not the products now sold are measuring up to the standard of sterility. But the test for catgut sterility is one which can be carried out by any laboratory equipped for anaerobic bacteriology and until either the government or some medical organization undertakes to control these products the proposed tests should be made in a reliable laboratory before any particular brand of catgut is adopted by any surgical clinic. Although improperly sterilized catgut may at times contain the organisms of tetanus or gas gangrene it probably very rarely contains non-spore-forming heat-susceptible organisms like staphylococcus and streptococcus which are the commonest organisms of operative wound infections. However as shall be seen presently the use of catgut in surgery may and almost certainly does favor the growth of organisms introduced at the time of operation.

*Contamination from the hands of operators.* We have stated above that doctors and nurses frequently contaminate their hands with purulent discharges from the wounds of patients when changing their dressings or handling their bedclothes. (If gloves are used at the time of dressings such contamination is minimized.) If the doctor or nurse then proceeds to the operating room the possibility of carrying those organisms to the sterile field is a very real one. The scrub-up is the intervening barrier. In almost every hospital the surgeons scrub their hands with soap and water for a variable length of time. In this procedure the time is not as important as the vigor with which the superficial layers of skin and the crevices and grooves are scrubbed. Countless organisms are removed in this process. The after-treatment of hands then varies considerably in different clinics. Some use alcohol, others,

bichloride, bimodide, lime and soda, iodine, or a combination of these. The antiseptic effect of these chemicals depends upon their close contact with the bacteria and the duration of this contact. Our present technique calls for a 5 minute scrub-up with green soap in running water and 5 minutes by the clock in lime and soda followed by 70 per cent alcohol. For those whose skin is irritated by the lime and soda, the time may be abbreviated but the nails must receive a generous supply and be cleaned with the antiseptic. The full time of 10 minutes must then be completed in the alcohol. Cultures from the hands and nails following this treatment rarely show organisms. Lime and soda seems to be particularly effective and the odor of chlorine may frequently be detected under the nails several hours after the operation is over. There is a tendency on the part of certain surgeons at times to shorten the various steps in the scrub-up and I am convinced that when this is done organisms are carried over to the sterile field. An added safeguard lies in having the sterile nurse hold the glove open so that the hand may be inserted without touching the outside. If gloves are broken or pricked during the operation good practice demands a change at once because the hands, even if sterile at the beginning of the operation may be contaminated by skin organisms discharged from hair follicles or sweat glands later on. The method of using wet gloves makes it impossible to prevent contamination of the outside of the glove with organisms still present on the hands.

*Contamination from the skin of the patient.*

In the earlier years of our study there was an urgent demand for a skin antiseptic to replace the time honored iodine which has been criticized because it occasionally produces burns and does not effect real sterilization of the skin. Picric acid, acridavine, gentian violet, mercurochrome various other dyes and combination of dyes, hexylresorcinol metaphen and merthiolate have all been recommended by enthusiastic advocates and statistics have been presented to prove their worth but the results that we have obtained in experimental animals have not consistently indicated the superiority of any skin antiseptic over the others. We at-

The bacteria contained in the deep ducts and glands may again become of some importance during the skin set-up. If a continuous suture is used the needle may pick up organisms and distribute them all along the suture line. This source of contamination may be minimized by using individual interrupted sutches on separate needles as Halsted advised.

*Contamination of the wound from air organisms.* Lister believed that organisms dropping from the air played an important role in wound infection and developed his elaborate apparatus for spraying the atmosphere. It later developed that this was one of the relatively minor factors. However, with the other sources greatly reduced or eliminated, if nothing is done to minimize contamination from this source it becomes relatively important again. If a blood agar plate is exposed to the air of an operating room for an hour and then incubated, its surface will be more or less thickly covered with dust particles, and beneath some of these particles colonies of bacteria of various kinds develop. Staphylococci will make up the majority of these colonies. Yellow and white, hemolytic and non-hemolytic will all be represented. Bacillus subtilis, Bacillus coli, non-hemolytic streptococci and diphtheroid bacilli will be present in smaller numbers. Hemolytic streptococci will appear rarely. Yeasts and moulds are relatively common. The number of colonies will depend upon a number of factors. In the old hospital one operating room was on the ground floor and a second on the floor above. Cultures from the ground floor operating room were consistently more numerous than those from the upper floor and yielded roughly two colonies for every minute of exposure. In the new hospital, with the operating rooms on the sixteenth floor, the colonies were found to be just half as numerous as they were in the old hospital, namely, one colony per minute of exposure. The fresh air supplied to these rooms is filtered by the operation is pulled by the opening of doors, the occasional coming and going of assistants, the spread of blankets and the general movement of the people connected with the operation. If plates are exposed in one of these rooms when no operation is going on and no

attempted to compare iodine with mercurio-chrome-acetic-alcohol which was said to have extraordinary penetrating qualities. At the beginning of a hernia operation, 5 minutes or more after the antiseptic had been applied, a bit of skin from the region of the pubic hairs was cut out with freshly boiled instruments and transferred at once to cultures medium. Of ten cases prepared with iodine, 9 yielded growth of staphylococci, Bacillus subtilis or diphtheroid bacilli, 2 of these wounds developed trivial infections. Of 10 cases prepared with mercuriochrome, 8 showed growth. One of these yielded Bacillus coli, Bacillus welchii and staphylococci and developed a serious infection. "Not much to choose," you will say, "between the two, both being inadequate, say, stenizers." That is true, and we have repeatedly carried out this same test in animals with the other antiseptics. After contamination of the skin of rabbits with mixed cultures of common organisms—such as Bacillus coli, Bacillus subtilis, Bacillus welchii, staphylococci and streptococci, we have applied the antiseptics for varying lengths of time and then snipped out bits of skin for culture. No antiseptic yet proposed has shown any superiority over iodine. If the organisms in the deep glands and ducts of the skin cannot be destroyed by any antiseptic yet found, the knife which passes through the ducts and glands must contaminate the wound with the organisms contained therein. This might be avoided by using the electric "cutting current" or by employing a knife blade soaked in carbolic acid. However, the injury to the tissues from cauterization or antiseptic might offset the advantage gained. If a knife is used it may be considered when the skin has been incised. Greater contamination of the wound may take place during the course of the operation if the skin sections almost certainly wash out bacteria from the ducts during the course of an hour and these reaching the surface may be wiped into the wound unless the skin edges are protected. This may be done most effectively by attaching towels to the skin margin with Michael clips. Emphasis should be made of the importance of a careful preliminary gauze sponge scrubbing of the skin with alcohol and then either or either alone before applying the iodine.

TABLE I—THYROID OPERATIONS

	Totals	Infect.	Per cent	Hæmat	Per cent
1926	57	10	18	16	28
1927	77	13	17	30	39
1928	78	8	10	29	37
1929	163	20	13	60	35
1930	189	4	2	29	15
1930 Catgut	35	2	6	15	45
1930 Silk	154	2	1	14	9
1931	216	4	2	19	13

1930 Average number days in hospital cat-gut cases

12

1930 Average number days in hospital silk cases

9

one moving in or out, the number of colonies appearing on the plates is just one tenth of that developing on plates in a room where there is activity during an operation. In these rooms visitors are required to observe the operations from a balcony protected by plate glass. If visitors are permitted to come on the floor of the operating room as is the case in many places it is obvious that the number of air organisms are materially increased, especially when the visitors are not properly masked.

The area of a blood agar plate is approximately 7 square inches. The sterile field including the operating table and instrument tables might vary from 4 000 to 7,000 square inches. It would seem fair to assume, therefore, that in a busy operating room in the course of an hour from 35 000 to 60 000 bacteria fall upon the sterile field. It is obvious that these figures may be materially reduced by minimizing the activity within the room and the opening and closing of doors by removing objects which collect dust and by refusing admittance to unnecessary persons.

Canopies over instrument tables cut down air contamination. Street shoes should be covered. Walls and floors should be frequently washed with germicides. Constant filtration of the air might be of considerable value, where dust is prevalent.

#### FACTORS WHICH FAVOR THE DEVELOPMENT OF WOUND INFECTION

*The factor of local tissue susceptibility.* During the first 5 years of our study our chief efforts in our attempts to reduce the number of our infections, lay in considering ways and means of reducing the sources of contamination. It is obvious that every wound becomes contaminated at the time of operation, but fortunately relatively few become infected. One reason for this, which we assume but cannot prove is that individual patients may vary in their susceptibility to infection. It is almost self-evident also that trauma and rough handling of tissues decrease the local resistance to infection. Extravasation of blood, the use of drains, mass ligation of tissues and the tension upon or strangulation of tissues by sutures or retention stitches as well as the mechanical factors of motion (as in certain wounds of the face, neck, and extremities) or distention from within (as in abdominal wounds) play a role by breaking up the fine fibrinous network of the early stages of repair or by cutting down the blood supply.

*The factor of suture material.* During the first 5 years of our study it was evident that certain types of operation regularly had a higher incidence of infection than others. Radical mastectomy, partial thyroidectomy, recurrent hernia, ventral hernia, open reduction of fractures headed the list. There seemed

TABLE II—1931 SILK VERSUS CATGUT

	Inguinal Hernia						Fracture Service					
	Total	Hæm	Per cent	Ser	Triv	Per cent Inf.	Total	Hæm.	Per cent	Ser	Triv	Per cent Inf.
Catgut	100	14	14	1	4	5	38	11	29	2	5	18
Silk	40	0	0	0	0	0	70	1	1	0	0	0
Silk and Catgut	8	2	25	0	3	38	10	4	40	0	1	10
Not stated	5	0	0	0	0	0	10	0	0	0	0	0
Totals	162	16	10	1	7	5	137	16	12	2	6	6



## MILITARY INFECTION IN CLEAN OPERATIVE WOUNDS

TABLE III-1932 SILK VERSUS CATGUT

[illegible]

to be a reason for this in the nature of the operation except in the case of partial thyroidectomy. Practically all of the thyroid operations were being done by the two surgeons associated with the thyroid clinic and it did not seem possible for them to reduce their high incidence of haematoma and infections in the summer of 1929, while one of the thyroid surgeons was on his vacation, the author had the opportunity of performing 5 thyroid operations in close succession. As had been his habit since China, under the leadership of Dr Adrian S Taylor, a former pupil of Dr Halsted, the author used fine silk entirely for ligature and suture material in these cases. The differences in the healing of these wounds compared with the catgut sutured wounds was obvious to all who saw them. The second thyroid surgeon observed these results and was persuaded to

TABLE IV—1933 WOUND INFECTIONS IN RELATION TO SUTURE MATERIAL

All Cases										Thyroids										
Sole		5	0	517	97	5	0	0	51	Total		5		0	517	97	5	0	0	51
Catgut		357	327	91	6	2	23	7	20	8	27	8	0	0	0	0	0	0	0	0
Linen		23	13	95	5	2	3	2	6	4	12	10	120	123	95	3	2	3	3	0
Combined		11	13	92	0	0	1	8	2	8	1	8	0	0	0	0	0	0	0	0
Not stated		104	101	97	1	1	1	2	3	5	2	15	100	0	0	0	0	0	0	0
Total		773	707	95	13	12	41	36	54	5	62	55	247	241	98	3	2	1	6	10
Primary Inguinal Hernias										Radical Breasts										
Silk		141	137	97	1	0	7	3	4	5	2	1	9	9	100	0	0	0	0	0
Catgut		40	38	95	2	5	0	0	2	5	3	13	10	6	60	0	0	4	40	2
Linen		4	4	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not stated		3	3	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		188	18	15	3	2	7	3	6	3	5	3	9	28	79	0	0	0	0	0

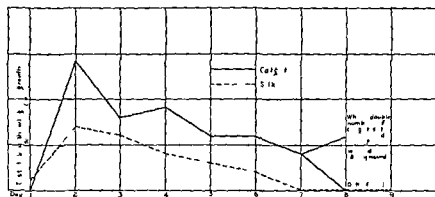


Fig 1. Silk and catgut sutures comparisons

surgeons agreed to use it on all hernias. In the next year's report an opportunity was given to compare silk and catgut in these 2 large groups. Again the superiority of silk was demonstrated unmistakably, as Table II shows clearly. In the last 2 years silk has been substituted more and more for catgut. In 1932 we were able to compare silk and catgut in 3 large groups (see Table III). In 1933 a large majority of all clean wounds were sutured with silk. For the first time we were able to compare all of the cases closed with silk with all of the cases closed with catgut (see Table IV). The results amply confirm the early reports and we have come to feel that this one modification in our technique has been more important than any other in reducing our wound infections. In 1933 the 2 thyroid surgeons experimented with linen as a substitute for silk but their results were unsatisfactory as Table IV so clearly shows.

As we have said above Halsted following the lead of Kocher in Berne, substituted silk for catgut in suturing clean cases partly because of the uncertainty of catgut sterilization in those days and partly because he noticed that the wounds healed "more kindly" even when there was no infection. There was less redness, swelling and induration. Thus, he became the chief advocate of the use of silk in this country and his pupils have almost all followed his example and spread this gospel abroad. On the other hand, few surgeons who did not come under his influence either directly or through his followers and pupils have been convinced that he was eminently right in his

conviction nor have they been willing to change their technique in this respect.

It seems strange that Halsted did not attempt to prove his point either by well controlled clinical or careful laboratory experiments. He was sure of his ground on the basis of his own experience and his own observations. In 1925 B. H. Goff made a study of wound infections in clean cases and presented fairly good evidence that wounds sutured with silk were less likely to become infected than when other materials were used. Our results amply confirm the impression which he obtained from his study. During the past year Vivier, one of the senior fellows in our surgical department at the suggestion and under the supervision of the director of the service, has added clean cut evidence from a series of animal experiments, which strongly supports the view that silk is superior to catgut. With rigid operating room technique he produced two wounds extending through the wall of the abdomen in a large series of rabbits. One side was sutured in layers with finest silk and the other with the finest catgut. Each side was operated on with completely separate sterile set ups and took the same length of time. One animal in the series was sacrificed each day for 10 days. Cultures were made from these wounds in a dust proof chamber and by taking approximately 1 cubic centimeter of tissue from each side an effort was made to estimate the number of viable bacteria actually present on its surface by shaking the tissue in 5 cubic centimeters of broth and diluting this down through a series of 1 to 5 dilutions.

TABLE V—ASSOCIATION OF DRAINS AND HÆMATOMATA WITH INFECTION—AVERAGE 7 YEARS

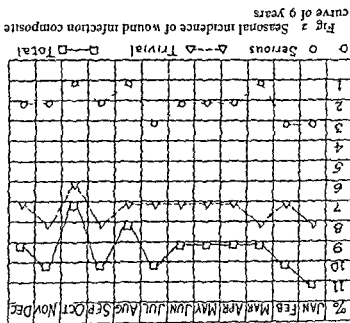
Drained, Infected	11.5
Not Drained, Infected	7.6
Hæmatoma, Infected	20.4

TABLE VI—PROBABLE SOURCE OF INFECTION

Contaminated at operation	34
Contaminated at dressing	11
(Alibi) contaminated before operation?	2
Questionably counted	3

TABLE VII—DAYS IN HOSPITAL AFTER OPERATION—AVERAGE 5 YEARS

Clean	12.4 days
Infected	23.3 days
Hæmatoma	16.1 days



become infected than when either is used alone. This is probably due to the fact that in a wound in which organisms are able to gain a foothold easily, silk acts as a foreign body which must be extruded. For the same reason silk should not be used in clinics or by operators who are not willing to strain every effort to minimize contamination by all of the methods mentioned above which have been devised for that purpose, or by those who are not willing to minimize trauma to the tissues or tension of the tissues during the operation, or by those who are not willing to take the time to obtain perfect hæmostasis, or by those who are not willing to mask adequately both nose and mouth. My chief, Dr. Allen Whipple, emphasized these points in an admirable review of the subject which appeared last year in the *Annals of Surgery* and I desire to reiterate them emphatically here. However, I am willing to predict with confidence that any surgeon who will perfect his technique in these respects will be able to obtain "kinds" wound healing with fine silk, than he is now obtaining with catgut with or without those refinements of technique.

*The role of drains and hæmatoma.* During the last 9 years we have studied the role of drains in the production of infections. In every year but one, a larger per cent of infections developed in the drained cases than in the undrained and the average per cent of infections in drained cases greatly exceeded that in

In practically every case the catgut wounds contained more bacteria than the silk wounds, as Figure 1 shows. Microscopic sections showed that the cellular and fluid exudation around the strands of catgut was infinitely greater in amount than around the silk. Therefore, we now have both clinical and experimental evidence of the superiority of silk.

We believe that the superiority of fine silk over catgut is due to the following facts. First of all hæmostasis is better, for the silk knots do not become untied as easily as catgut knots, particularly when the wound surfaces move more or less constantly as in the thyroid operation. Second, the cellular and fluid reaction about silk is minimal, while the reaction about tissues. Catgut is dead tissue which must be digested. In the third place the use of silk automatically requires the surgeon to be more gentle with the tissues. His sutures and ligatures are less likely to be pulled tightly enough to strangle tissue. This often happens when catgut is used and increases with the postoperative œdema. For these reasons, with a certain inevitable amount of bacterial contamination, infection is more apt to develop in tissue in which catgut has been used than where silk has been employed. Halsted observed, and our statistics as well as our tissue sections prove, that wounds sutured with both silk and catgut are more apt to

TABLE VIII—WOUND INFECTION 9 YEARS

Year	Total	Clean	Per cent	Serious	Per cent	Trivial	Per cent	Tot Inf	Per cent	Hæmat	Per cent
1915	558	482	86	20	4	56	10	76	14	77	5
1916	581	404	85	22	4	65	11	87	15	54	9
1917	653	555	85	16	3	82	12	93	15	95	14
1918	640	571	89	10	2	59	9	69	11	80	13
1919	771	703	91	17	3	51	7	68	9	141	18
1920	747	674	90	23	3	59	7	73	10	108	14
1921	90	833	93	16	17	51	54	67	71	97	10
1922	1053	997	95	12	11	44	42	56	53	57	54
1923	1132	1078	95	13	11	41	36	54	48	62	55

the undrained cases, but we cannot be sure whether this was due to the drains or to the condition which seemed to the surgeon to require drainage (Table V). There is no question, however, about the rôle of hæmatomata. Wounds which develop collections of blood or serum are unquestionably more prone to become infected either because of organisms introduced during the operation or later during dressings. Our studies have seemed to show that wounds may become infected following secondary contamination at the time of dressings as well as primarily from contamination introduced at the time of operation. This applies chiefly to wounds which develop hæmatomata or necrosis of skin from excessive tension. In a few cases each year there has been a good excuse for the development of an infection independent of the operating room technique. These points are brought out in Table VI.

#### PROLONGED HOSPITALIZATION OF INFECTIONS

It seems important for surgeons as well as hospital superintendents to know that patients with clean wounds which become infected have to stay in the hospital about twice as long as they would if their wounds had remained clean. This fact is shown in Table VII.

#### ANNUAL RESULTS FOR NINE YEARS

During the past 9 years we have gradually modified our operating room sterile technique to conform with the facts which we have presented above and we have gradually reduced our infections to a third of the former figure, as Table VIII shows. Time will tell whether

or not we have reached the irreducible minimum.

The composite curve showing the seasonal incidence of wound infection is shown in Figure 2. It does not show the spring peak which appeared in Dr Walker's curve and in our own (7) when hæmolytic streptococcus was prevalent before the period of adequate masking.

#### SUMMARY

1. We have carefully studied the question of the infection of clean operative wounds and have shown that general impressions of the incidence of wound infection is erroneous unless backed up by carefully prepared statistics.

2. We have considered the possible sources of contamination and we believe that the important origins are (a) the nose and throat of the operating personnel, (b) the hands of the operating personnel, (c) the skin of the patient, (d) the air of the operating room, and (e) the instruments and materials used in the operation.

3. We have suggested ways and means of minimizing contamination from all of these sources, placing particular emphasis on efficient autoclaving and the proper masking of the nose and mouth of the operating personnel.

4. We have considered also the factors in the wound itself which favor the development of an infection, laying particular stress upon the advantages of fine silk over catgut as ligature and suture material. We have stressed the necessity for perfecting all of the steps in sterile operative technique if fine silk is to be used successfully.

5. We have shown a steady improvement in avoiding wound infection following the

gradual modification of our technique based upon results of our study.

6 The study has been of interest to every member of the staff. It has rendered his "infection conscious" and stimulated his efforts to reduce further the incidence of wound infection.

7 Theoretically, there is an irreducible minimum in the incidence of wound infections. We do not claim to have arrived at that point.

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## Discussion

We have considered as an epidemic of wound in fectious due to the hamolytic streptococcus a situa tion where there were 3 or more infections of clean surgical wounds due to the above mentioned or ganisms occurring on a service simultaneously or at near intervals. As a result of observations and a study of masks, we have made the following findings which may be of some value in the prevention of hamolytic streptococcus wound infections of the epidemic nature.

1 In the 4 epidemics cultures from the hands, sterile goods, instruments, solutions, etc., showed no evidence of the hamolytic streptococcus.

2 Study of the masking situation showed that masking was inefficient in the 4 epidemics.

3 All 4 epidemics of sepsis occurred during epi demics of respiratory disease.

4 Three out of the 4 epidemics of infection occurred during the winter months when epidemic respiratory disease is most prevalent in this part of the United States.

5 In the 4 epidemics, both surgical, more care fully studied, the percentage of streptococcus car riers in the operating room personnel, including the surgeons, was 50 per cent and 58 per cent, respec tively.

Among those patients with clean wounds which became infected with the hamolytic streptococcus, the percentage of those having hamolytic streptococcus epidemic somewhere carefully

period of time allotted for the discussion of Dr. Meltenev's interesting paper, I shall consider only one aspect of the infections of clean surgical wounds, namely, that of the so called epidemic hamolytic streptococcus infection occasionally occurring on surgical services.

The late Dr. Arthur T. Cabot, surgeon to the Massachusetts General Hospital, once made the statement that every surgical operation was an experiment in bacteriology. If one accepts the fact that all surgical wounds, the clean as well as the infected, are accompanied by bacteria from an ex trinsic source, then one can appreciate the wisdom of the above statement. Fortunately, in the case of the clean surgical wound these bacteria are usually not pathogenic and therefore cause no harm.

When, however, there chances to be a strain of pyogenic organisms of considerable virulency, and as a contributory factor a lowered resistance on the part of the individual, an infection of the wound may result, with its morbidity and possible mor tality.

It so happens that we have had the opportunity to observe 4 epidemics of hamolytic streptococcus infection, 3 on surgical services and 1 on an obser vical service, in Massachusetts hospitals. In 2 of these—both surgical—we were able to study the epidemic somewhat carefully.

cocci in the nasopharynx in the 2 epidemics studied was 22 per cent and 31 per cent, respectively. In fairness it should be stated that all bacteriological studies in these 2 epidemics were made after the sepsis was discovered.

6 A study of masks submitted from 60 hospitals in the United States showed that none could be considered efficient from the point of view of preventing the passage of organisms through the material under all the conditions for which a mask might be called upon for service and that the variables in the efficiency of the masking situation were as follows: (a) whether or not the nose as well as the mouth was covered, (b) materials used in the mask, (c) thickness of the material, (d) duration of the operation, (e) whether or not the mask became moist, (f) the amount of conversation carried on by those masked.

7 We concluded that the ideal surgical mask should be one that—(a) under all conditions will absolutely prevent the passage of organisms through the material of the mask in the direction of the wound or material concerned with the operation when both the nose and the mouth are covered, (b) will be comfortable in all degrees of temperature

and will not fog glasses, (c) will be of low original cost, or of such construction that it can be used economically many times with sterilization following each use. (We might state in passing that we have not found the ideal surgical mask.)

8 Theoretically, if all other aspects of aseptic technique can be assured, epidemics of hemolytic streptococcus wound infection can probably be prevented by eliminating from the operating room all who are streptococcus carriers. This seems not to be feasible because of the rapidly changing bacteriology of the nasopharynx. The danger of such epidemics can be lessened by forbidding any individual who has the slightest inkling of an upper respiratory tract infection to enter the operating room. A practical procedure to minimize such infections should be the use of a mask during epidemics of respiratory disease and during the winter months, the materials of these masks to be impervious to currents of air even though they are not as comfortable as could be desired.

We offer for further intensive study the query as to the likelihood of hemolytic streptococcus carriers among surgical patients infecting their own wounds by the hematogenous route from a focal infection.



duct, with irrigation of the duct system. Desjardins has had good results from treatment by X ray but considers radium more convenient for the patient. Favorable results when they occur are noticed within 48 hours. Blair (3) advises radical drainage of the lesion if it has progressed for 48 hours.

It would seem the part of wisdom to utilize the more conservative methods early and in the University Hospital we give treatment by radiotherapy either with radium or the X ray as soon as the swelling in the parotid is noticed. At the same time the duct is dilated so that drainage from that avenue may be possible. If, however, the lesion is not favorably affected by these methods, it is not wise to wait indefinitely for the appearance of fluctuation before instituting drainage of the gland. The parotid has a fibrous covering of such density that death from sepsis may occur before fluctuation is detectable. If the process is still active and progressive on the third to fourth day in spite of conservative treatment and if the patient's condition usually determined by the concomitant lesion permits the drainage already described should be carried out and the entire gland including the deep portion, should be explored and drained.

#### VISCEROVASCULAR FASCIAL SPACES

The three muscular fascial spaces of the face have been briefly outlined in relation to their surgical importance. In Figure 9 is shown a surface projection of these spaces. The only viscerovascular space that need be considered in relation to the face is the lateral pharyngeal or pterygopharyngeal space, which is shown in vertical and horizontal section in Figures 2 and 3. This space is of great importance to the otolaryngologist but is involved so frequently in cases of some of the more superficial infections that it must be briefly considered here. It is bounded anteriorly by the mesial wall of the masticator space laterally by the parotid space, posteriorly by the carotid sheath and its contents and medially by the pharynx and its fascia. Above it is limited by the base of the skull and below by the submaxillary gland with its fascial sheath.

Infection of the pterygopharyngeal space as already indicated, may result from such in-

fections in the lateral wall of the pharynx as tonsillitis or peritonsillar abscess. The space may become infected secondary to infections of the retropharyngeal or the parotid space, but not from the masticator space, since the internal pterygoid muscle intervenes between these spaces.

Once infection has reached the lateral pharyngeal space the internal carotid artery is in danger of necrosis and the internal jugular vein is liable to septic thrombosis. It is apparent therefore, that infections in the parotid gland may result in the grave complication of hemorrhage from the internal carotid artery or septic thrombosis of the internal jugular vein. Early drainage of parotid infections will often prevent infection of the pterygopharyngeal space. The space should be drained either internally through the lateral pharyngeal wall or externally as indicated in the description of the method of draining the deep portion of the parotid gland. If even a mild hemorrhage should occur, the common carotid must be immediately ligated. As stated at the outset infections in spaces formed by vascular fascial planes easily follow these planes to adjacent areas. Infection in the lateral pharyngeal space passes without hindrance into the carotid and jugular sheath and thence into the vascular visceral spaces of the neck and mediastinum.

Another small space of some surgical interest may be seen in Figure 3 between the jugular vein and the stylohyoid and digastric muscles. It contains lymph nodes of the deep cervical chain that drain the above mentioned regions and may be the site of severe lymphangitis and abscess formation which infection may extend along behind the carotid sheath to the supraclavicular fossa. Infection in the space between the jugular vein and the stylohyoid and digastric muscles gives rise to marked tenderness along anterior and posterior borders of the sternocleidomastoid muscle.

#### UPPER LIP AND NOSE

The last important region of the face to be considered is that bounded laterally by the masticator spaces inferiorly by the lower border of the mandible, and superiorly by the hair line. In this region lie the lips, nose, cheek,





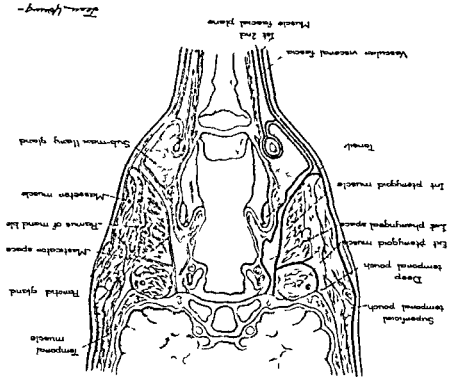
Fig. 1 Dissection of the first muscular fascial plane of the face and neck, and its continuity. This plane can be seen deep to the parotid gland, its duct, and facial nerve and vessels. A, Skin; B, platysma and subcutaneous tissue; C, parotid, masseter space; D, parotid; E, external jugular; F, great auricular; G, first muscular fascial plane

cutaneous tissue. A tributary of the fascial superior ophthalmic vein, which in turn empties into the cavernous sinus. Under normal

The organs of the special senses present highly special problems that should not be considered here. This region is covered by loose skin and subcutaneous tissue. Underneath lie the muscles of expression that take origin from the bones of the face and that are inserted into the deep portion of the skin. These muscles do not have a fascial covering but are surrounded by subcutaneous tissue. Therefore in this region there are no fascial planes to limit infection which spreads easily in the subcutaneous tissue.

A rich plexus of vessels lies deep to the muscles of expression, they, too, are surrounded by the subcutaneous tissue. The skin, being attached directly to the muscles of expression, it differs constantly in motion. In this respect it differs from the skin of the body. The relative immobility of the facial skin tends to prevent the localization of infection. The venous drainage of this portion of the face is collected by the facial vein and normally carried to the internal jugular vein. There are no valves in the veins of the face and their walls are less flaccid than those of other veins because of the firm support afforded by the sub-

Fig. 2 Frontal section demonstrating the different fascial planes and potential anatomical spaces.<sup>1</sup> Drawings from dissection by authors





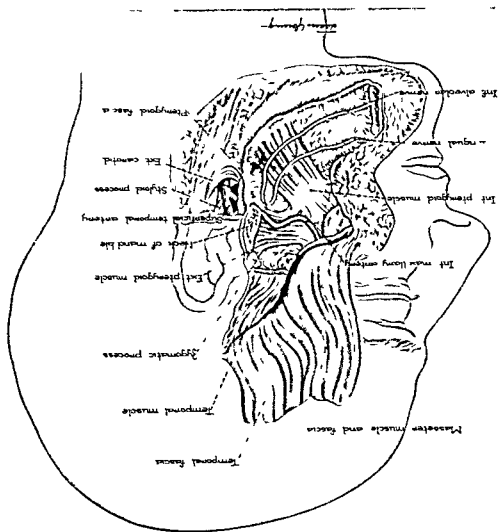


Fig 6 Dissection of the medial wall of the masseter space after reflection of the external wall and removal of the mandible. The pouch of the deep portion of the parotid gland can also be seen as the parotid gland has been removed. (See footnote, Fig 2.)

it with the cavernous sinus. When the facial vein or its tributaries are obstructed by thrombophlebitis or by pressure from edema or exudate, the current may be reversed and septic emboli may pass to the cavernous sinus, resulting in bacteremia, meningitis, or sinus thrombosis. Progressive thrombosis of the facial, angular, and superior ophthalmic veins may eventually reach the cavernous sinus. Infections of the upper lip, the external surface of the nose, and the external nares are all ways in danger of developing these highly fatal complications.

Infections in the upper lip may be due to streptococci entering cracks and fissures at the junction of the nasal mucous membrane and the skin, in this case erysipelas of the face.

Results. A more serious type of infection arises from staphylococci with invasion of the skin and soft parts of the lip itself. Such an infection may range from tiny pustules to a carbuncle involving the entire face. Certainly the huge majority of pustules are self-limited and cause no more than a slight annoyance. At any time injudicious treatment by patient or surgeon may change the clinical picture from a harmless lesion to one that may be rapidly fatal. It is well to emphasize the fact that bacteremia, meningitis, and cavernous sinus thrombosis may develop from a traumatized pimple. Squeezing a pimple, endeavoring to abort a pustule or furuncle by incision or by the introduction of an antiseptic, may initiate the spread of infection by continuity



Fig 7 Dissection showing the superficial portion of the parotid gland and its internal and external relations to the facial nerve. The space between the masseter muscle and parotid gland is well shown. A Skin B subcutaneous tissue C masseter muscle and fascia D parotid masseter space E external jugular vein F parotid gland G greater auricular nerve H superficial portion lower pole of parotid gland

and by the blood stream. It is probable that the great majority of severe infections of the upper lip and nose were originally mild infections that were converted to severe infections by ill advised treatment.

#### TREATMENT OF INFECTIONS OF THE UPPER LIP

The treatment of these infections will vary in character with the location, size and stage of the infection. First, no pimple or pustule, no matter how small, should be squeezed or traumatized. J. B. Brown's (4) suggestion of covering the pimple with adhesive plaster in order to splint and protect it seems a sound one. In from 1 to 2 days the lesion should have virtually disappeared.

Any infection larger than a pimple, such as a furuncle or carbuncle in the lip and nose, should be treated by bed rest in a hospital. The results obtained from radiotherapy in the hands of many observers is so favorable that some form of this therapy should be tried. It may abort the early lesions and break down the late ones. This treatment should be given at the earliest possible moment in order to produce the best results. When a carbuncle

exists every effort should be made to reduce the activity of the lip to a minimum, talking should be prohibited and in extensive lesions feeding by a nasal tube should be used. A hot moist dressing gives comfort and perhaps aids in recovery.

When the process has extended more widely, with the signs and symptoms of generalized infection present, it is possible that septic thrombophlebitis is present and one is faced with deciding whether to ligate the angular vein. There is no unanimity of opinion on this question. Brown (4), writing from the service of Wilray Blair, states that ligation of the angular vein is not practiced in that clinic. Schileau in 1910 and Bullock in 1912 reported a case of ligation of the facial vein for cellulitis of the lip with recovery. Roeder reports a favorable result from this procedure and Hamilton Bailey advocates the measure and reports 3 favorable cases. In the face of a lesion of such potential gravity it would seem advisable to carry out an operation of a minor nature such as this if there is a chance of preventing generalized infection or cavernous sinus thrombosis. If carefully performed with a small amount of local anesthesia, the procedure can hardly be said to increase the dangers of the disease. Bailey states that "a sign which foretells impending danger is spreading oedema from the lip to the inner canthus and this is usually found in the presence of suffusion of the eyelids. As far as my own observations have gone the premonition is invariably unilateral. If in addition to this sign there is considerable elevation of temperature the call for action is imperative."

Ligation of the angular vein can be easily carried out through a short incision carried down and slightly out from a point below the inner canthus along the junction of the nose and cheek. The angular vein is found lying in or under the fibers of the levator labii superioris alaeque nasi muscle. The operation is deserving of further trial in certain cases of infection that is progressing up the cheek and nose and whenever the presence of thrombophlebitis is suspected.

If frank pus is present in the upper lip drainage is usually advisable. Many pro-



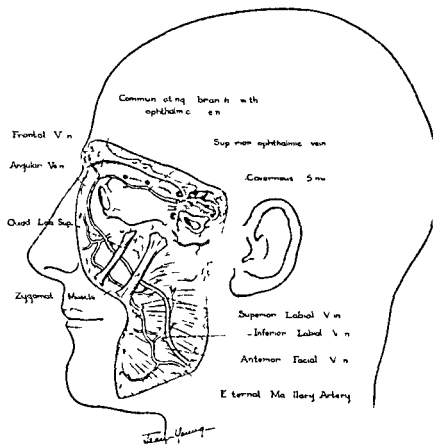


Fig. 10 Dissection showing the course of the anterior facial vein and its anastomosis with the superior ophthalmic vein. (Adapted from Testut.)

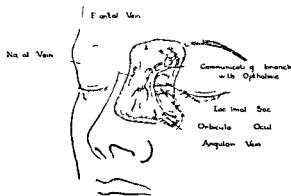


Fig. 11 Dissection of the region where the angular vein may be ligated.

space lies deeper between the geniohyoid and the mylohyoid muscles. This is also bounded laterally by the body of the mandible and divided in the middle by the same fascial septum. Another potential space that may be involved lies between the mucous membrane and the genioglossus muscle in which lies the sublingual gland. Infection in the first mentioned areas gives rise to the clinical picture first described in 1836 by von Ludwig and still called Ludwig's angina.

**Ludwig's angina.** This infection gives rise to a clinical picture so constant and so severe that it has received much attention from surgeons. The diagnosis is made on the findings of an infectious process in the floor of the mouth in the spaces already described. There is an elevation of the tongue and redness and oedema of the mucous membrane over the



Fig. 12

Fig. 12 Dissection showing sagittal section through the floor of the mouth showing spaces in the floor of the mouth 1, Mylohyoid muscle, 2, space between geniohyoid and mylohyoid muscles, 3, geniohyoid muscle, 4, space between geniohyoid and geniohyoid muscles, 5, geniohyoid muscle (Courtesy Dr. A. C. Furstenburg)



Fig. 14

Fig. 14 External approach to spaces between the mylohyoid and geniohyoid muscles (Courtesy Dr. A. C. Furstenburg)

Fig. 15 Approach through mouth to the spaces between the geniohyoid and geniohyoid muscles (Courtesy Dr. A. C. Furstenburg)



Fig. 15

definite origin and always spreads along certain planes. If neglected, infection may of course break through the anatomical barriers but originally it had definite boundaries and was a definite clinical entity. The treatment of Ludwig's angina consists in early surgical drainage of the infected area. The technique of operation varies according

involved area. The infection may be unilateral when the tongue is pushed to the opposite side, or it may be bilateral when it is pushed toward the roof of the mouth. The redness and edema of the mucous membrane of the floor of the mouth are marked, pressure of the swollen mucous membrane against the teeth often leaves an imprint. Discomfort is marked, swallowing is difficult, and speech becomes guttural. There is dribbling of saliva and the respirations become embarrassed. Dysphagia is not uncommon. There is a board-like swelling externally in the anterior aspect of the neck. There is no point of fluctuation and although the infection may be limited at first, soon it envelops the neck from side to side. The systemic reaction is often severe. Complications may arise from local or general extension of the infection.

Many papers have been written on the differential diagnosis of deep cellulitis of the neck and Ludwig's angina. It is highly probable that such a differential diagnosis is impossible since it is more than likely that there is no such original clinical entity as deep cellulitis of the neck. Infection always has a



Fig. 13 Frontal section through mouth showing floor of mouth divided by median facial angles indicated by crosses (Courtesy Dr. A. C. Furstenburg)

to the location of the infection, which is not always easily determined. If the abscess is below the geniohyoid muscles the region under the chin is prominent and occasionally gives rise to fluctuation, an incision should be made through the skin, subcutaneous tissue, and mylohyoid muscle into the abscess cavity as shown in Figure 14, and drainage tube introduced. When the swelling is uniform the incision should follow the lower border of the mandible so as to give access to both sides of the median fascial septum inasmuch as one cannot always tell accurately from examination which side is involved.

If the abscess is located above the geniohyoid muscle it may point under the tongue and can be drained easily through the floor of the mouth, the incision passing through the mucous membrane and the genioglossus muscle as shown in Figure 15. The spaces on both sides must be explored. Blind exploration with a blunt instrument may fail to open a small abscess but accurate dissection of the involved spaces usually will. When a neglected Ludwig's angina backs through the walls of these spaces, it usually breaks into the lateral pharyngeal fossa with the signs symptoms and complications already discussed in connection with that space.

The anatomical studies of the fascial spaces that have been made by M. Paul Truffert of Paris and by Prof. E. Stincer of the University of Havana have been of exceptional value to us.

#### SUMMARY

1. Facial infections may spread by direct continuity or by the hæmatopoietic or lymphatic systems or by a combination of these routes.

2. When the spread occurs by continuity, its direction is determined by 3 fascial planes that enclose spaces which are anatomically described.

3. Infections in the mandible are usually limited by the so called mandibular space, though extension may occur to the masticator space.

4. The masticator space may also become involved by infection of the zygoma and temporal bone. Methods of drainage of this space are considered.

5. Routes of spread of infection from supuration of the parotid gland and appropriate methods of drainage are discussed.

6. Infection of the upper lip and nose may cause thrombosis of the adjacent veins with resulting reversal of the venous flow. Infection or even thrombosis may then travel to the cavernous sinus. Infection of the lower lip may involve the spaces in the floor of the mouth and result in Ludwig's angina. This condition should first be treated conservatively but wide surgical drainage may become necessary.

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## Discussion

Dr. Elliott C. Cutler, Boston Dr. Collier has covered his topic in an admirable fashion and clearly indicated an important lesson for the surgeon. He has pointed out that in this field, as elsewhere, the chief lesson tells us when not to indulge in surgery and points out that simple infections often need the greatest care and wisdom. This emphasizes the importance of so called minor surgery and the fact that such conditions need the advice and care of the senior members of hospital staffs and should not be delegated to junior assistants. Too often we see septic hands and infections of the face cared for as ambulatory, dispensary cases until it is too late. Our distinguished past President, Dr. Allen Kanavel, and his pupils have pointed to a great lesson in emphasizing the dangers of infections of the hand and how to care for them. Dr. Collier makes a beginning for infections of the face, the seriousness of which is often recognized too late.

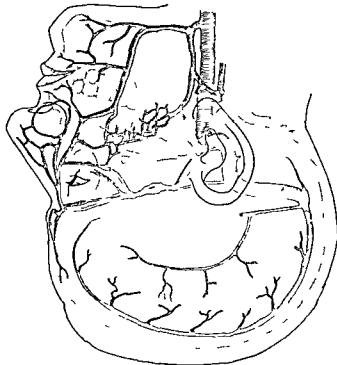
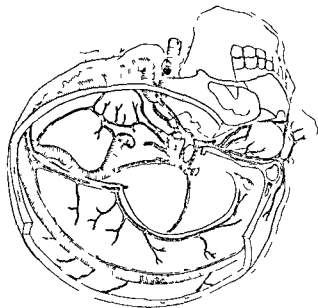
In an attempt to further Dr. Collier's lesson, I shall consume my brief time in discussing *carotid sinus thrombosis*, a none too rare and usually fatal complication of infections about the lip and nose. The infrequency of reports concerning this condition indicates not so much the infrequency of the condition as its hopelessness. The very triviality of the lesion often kills both the physician and the surgeon into a false sense of security. Thus one of the patients in our Peter Bent Brigham Hospital series was a nurse. A small furuncle appeared at the corner of her lip, the patient opened this with a needle, in 6 days she was dead with classical signs of *carotid sinus thrombosis*. Another case in this series began as a simple pimple just below the eye. This rapidly became a carbuncle. After 4 days' observation in the hospital, and 13 days after the first pimple appeared, excision with endothermy was carried out. The patient succumbed 6 days later with signs of disseminated sepsis including cavernous sinus thrombosis. A third case in the Brigham Hospital series was a member of the dental staff of a neighboring hospital, who acquired a small furuncle at the base of one hair in his mustache only 4 days before this lesion had spread to the whole lip and into the sinus and caused death. The fourth and fifth cases in my private series resulted from simple trauma. The first was a young boy struck by a baseball, who suffered a small contusion of his malar prominence, and the second was a little girl whose sister had slammed the door on her face, giving her a similar tiny laceration over the malar prominence. *Streptococci* entered these small abrasions. Within a few days swollen eyelids, fixed eyeballs, choked disc, and stiffness of the neck ushered in the fatal result.

The danger of such a complication is visualized by a study of the anatomy of the parts and it is per fas by a study of the anatomy of the parts and it is per fas blood vessel extension. The accompanying figures em-

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Figs. 1 and 2 Note anastomosis at upper inner angle of eye between superficial vessels and inferior ophthalmic vein, and the connection between the deep pterygoid vessels and the superior ophthalmic vein, and these veins has valves

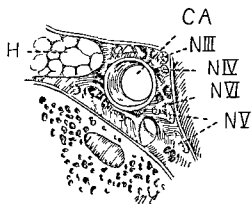


Fig 3 Transverse view cavernous sinus Note breaking up of sinus into innumerable contiguous compartments which greatly impede the flow of blood Also note position of third, fourth and sixth nerves and how easily disease of the sinus may affect them

phasize the anatomical extension of the infection by way of blood vessels. The major peripheral orbital tributary of the cavernous sinus is the superior ophthalmic vein. This unites at the inner upper angle of the eye with the angular vein, the supra-orbital vessels and the nasal vessels and other tributaries from the face and lip. But also there are fine anastomoses between facial vein branches and the inferior orbital vein and deeper in communications exist between the pterygomaxillary veins and the cavernous sinus. Moreover none of these vessels carries valves and the flow of blood is slow and often reversed. Phlebitis of any of these superficial vessels may lead to extension into the cavernous sinus. We all recognize that trauma with injury of the intima infection and stasis play the major rôles when thrombosis results. For some good reason perhaps not well understood but possibly to prevent respiration from exerting too sudden an effect upon intracranial pressure the cavernous sinus has a peculiar construction.<sup>1</sup> It is cut up into many contiguous compartments which must greatly impede the flow of blood. This may be excellent for the purpose of buffering the intracranial tension against sudden shifts due to respiratory changes but it also creates a most admirable condition for the extension of thrombophlebitis. When an infection is in the extremity we are not brought face to face with the great extension of thrombosis unless there be a resultant œdema of the extremity or a

subsequent pulmonary embolus. But when the extension occurs into such an important anatomical part as the cavernous sinus, where the mechanical arrangement of the sinus and the important structures lying near it call forth immediate clinical signs then it early assumes an alarming picture. The danger of such an extending phlebitis in relation to the face has long been recognized and surgeons have learned to withhold mechanical intervention whenever possible. Surgery by opening into vessels beyond the natural "walling off" process may permit bacteria to enter tributaries draining into the sinus. As cavernous sinus thrombosis progresses, the extra ocular muscles become paralyzed by involvement of the nerves lying in the sheath of the sinus. Vision is lost from thrombosis of the ophthalmic vein and this is preceded by an ominous choked disc.

There is no suitable therapy for cavernous sinus thrombosis though one finds occasional reports of cases where almost superhuman surgery has seemed to save a life. Thus there is a report by Browder of Brooklyn<sup>2</sup> telling how, in the face of seemingly definite thrombosis of the cavernous sinus on one side, he opened the cranium and completely obliterated the cavernous sinus on the affected side by the use of electrocoagulation. This apparently stopped the progress of the infection and though his patient lost the eye life was saved. A similar extensive procedure has been proposed by Eagleton<sup>3</sup> recently, the approach to the sinus being through the eye. This author also reports successful cases. Less radical surgery has on the whole proved meddlesome and costly. In a series of 23 cases treated in the wards of the Peter Bent Brigham Hospital for serious infections of the lip, nose or cheek—either carbuncle or cellulitis—there was a mortality of 30.4 per cent. In 10 of these cases some simple surgical procedure was carried out. In this group the mortality was 50 per cent against 21.7 per cent in the untreated group. And a study of the records showed no great difference in the cases.

Prevention of such a complication is what we most desire and in view of the anatomical considerations it seems wisest to urge conservatism for the moment in the treatment of spreading infections arising in the lip, nose or close to the eye particularly if the streptococcus is the etiological agent. Such conservative treatment will consist of heat to the local part and general care to the patient.

<sup>1</sup>Browder E. Jefferson. Carbuncle of nose ophthalmic vein phlebitis perforation for cavernous sinus thrombosis recovery. Report of a case. The Laryngoscope 1913 xliii 829-830.

<sup>2</sup>Eagleton Wells P. Cavernous sinus thrombophlebitis. New York The Macmillan Co. 1926.

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# EXPERIENCES WITH TUBED PEDICLE FLAPS

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pedicle, which has had many removes, great liberties can be taken with its blood supply

## ADVANTAGES

Its chief advantage lies in the readiness and

safety with which large quantities of skin may be transported from a distance. The tubed pedicle having been successfully made, its size can be increased either laterally or longitudinally so that huge quantities of skin can safely be transplanted. It is of particular use where no massive direct flap is available such as is usually used when body skin is transferred directly to the arm or forearm. Another of the characteristics of a tubed pedicle is that when once established its flexibility allows it to be twisted and turned in the most liberal manner without causing anxiety as to its viability. It lends itself to temporary attachment through an intermediate host

When the wrist is used as a means of conveying a large abdominal tubed pedicle flap one has given it an additional mobile pedicle whose base may now be considered to be at the shoulder. The flap can therefore be carried to any position of the body from the sole of the foot to the crown of the head or to any intermediate portion. The use of the wrist as an intermediate host is a great step in advance over the caterpillar method. Its viability has already been stressed. As a cosmetic flap it is at least up to the standard of any other type of flap except in one or two specific restorations

## DISADVANTAGES

The chief disadvantage is the time factor, which includes the financial aspect. For example, the shortest time that an abdominal flap can be transported to the neck works out in practice as shown in Table I

*Factors increasing the time* When flaps larger than, say 8 by 3 inches are required or when there are branch extensions of the flap some provision must be made for safeguarding the blood supply of these elongated masses such

A TUBED pedicle flap is a type of delayed flap in the form of a tube in which the long edges are sewed together. It is thus completely separated from its bed except at the two attached ends and is not replaced, as is a delayed flap. As for all types of delayed flap the object of the procedure is to induce a blood supply parallel to the long axis of the flap. The tubed flap is different from the other forms of delayed flap in that it prevents any form of granulation or scar tissue formation on its deep surface.

It was first described by Filatoff in 1917 (1), but the idea occurred to me quite independently in the same year (3). Its immense usefulness was immediately recognized by my colleagues in the War at Sidcup. It has since undergone many modifications and its field of usefulness has been extended. In the process its limitations have also been more accurately defined (4).

## GENERAL CONSIDERATIONS

The rationale of the flap is to increase its longitudinal blood supply at the expense of the transverse, so that it can survive on the blood supply of one end only. The idea is by no means new and the original Tagliacozzi (6) operation was a simple delayed flap. Other forms of delayed flap tend to produce considerable contraction from granulation tissue on the deep surface. The time factor is also different from that of the usual delayed flap as in my own experience I seldom, if ever, trust the blood supply at one end of the flap until a minimum interval of 3 weeks. Lymph stasis in the flap is also one to which consideration should be paid, some of the "tubes" undoubtedly show this condition, and if so, they can be left a further interval of time until the lymphatic circulation is established, their subsequent success as regards viability, adaptability, and cosmetic effect is considerably enhanced. In a long established tubed

168



FIG. 1. Tubed pedicle flap for nose. Direct application. Upper lip, eyelids, and eyebrows also grafted.

as making these tubed pedicles by stages undermining, delaying or partial division of

TABLE 1—TIME INTERVAL ABDOMEN—WRIST—NECK TRANSPLANTS

First Operation

The making of the pedicle followed by  
Interval 3 weeks

Second Operation

Transfer one end to wrist followed by  
Interval 3 weeks

Third Operation

Detachment of other end from abdomen,  
half opening out of pedicle flap and  
transfer of this half to the neck fol-  
lowed by

Interval 14 to 21 days

Fourth Operation

Separation from wrist and spreading out  
into the neck of the balance of the  
flap

Total time average 12 weeks

The whole of this time need not and should not be spent in hospital

the end of the pedicle that is about to be moved. Further the wrist is frequently inserted into the middle of the flap rather than to one of its extremities in order that the blood supply can flow equally to either end. All these minor variations require extra time and extra operation stages. The financial outlook, therefore both for patient and surgeon is not a rosy one. The time factor required from the



FIG. 2. Branched tubed pedicle for face—long acromio-pectoral type. Replacement of whole chin, upper lip, and

the whole of the left cheek. Separate nasal reconstruction. b. Branch pedicle for upper lip hidden behind pedicle.



Fig. 3 a) Iliac bone graft for mandible b) Conveyance to mandible c) Final result d) Koenigstgenogram showing bone graft in position



d

fibrous tissue in the untwisting process, full functional cosmetic success will not be obtained. Disappointments may also occur owing to a faulty plan in the first place. If, however, the technique has been carefully observed, both patient and surgeon will have a pleasant surprise in finding that the flap fits and looks well in its new bed.

#### TECHNICAL DETAILS

*The plan* As I have stressed many times, an accurate diagnosis of the loss of skin should

surgeon is also serious, as experience shows that to hustle any of the stages leads inevitably to an eventual delay or disappointment. Many stages however, can quite adequately be performed by a well trained junior. The other disadvantages of the flap are connected in my opinion with failure of the operation to observe the principles of technique, thus, he may shorten the interval, he may misjudge the viability of the flap, he may sew it up too tightly, or in some other way interfere with its blood supply. If he fails to remove the



Fig 4 Excision of jaw and soft tissues of chin and lip by Mr Gordon Taylor (London) Plastic repair by double

crossed tubed pedicles Bone graft and trimming Un finished

first be made Due allowance should be included in this estimate for the retraction or replacement of normal tissues into their normal position, when the scar has been excised Many experienced operators frequently fail to realize the full extent of the loss A great help can be obtained in this diagnosis as in any other by comparing the sound with the damaged part with a normal one A model is now made of the exact loss in sterilizable material I have published recently a technique for design of direct flaps which will be found eminently suitable for the tubed pedicle variety (3)

It is as well to cut the flap very slightly on the liberal side so as to allow for a final excision of its margins also for the ease of adaptation in certain situations an extra length of pedicle should be added to the flap proper

Some rules as to judgment of the proportion of these flaps must be given Thus a flap that was 8 inches long and only 2 inches broad would in my opinion be dangerous to make at one sitting Any flap of longer than 8 inches of any width should not be made at a single venture There enters the problem of the actual vitality of the skin of the patient under consideration This is a factor in which only experience can assist in the decision

**Incisions** Parallel incisions to the extent designed are made through the skin and subcutaneous tissues Again judgment must come into play as to the amount of fat to be included both as regards the restoration required and the presence or absence of a large quantity of subcutaneous fat In spare

subjects for instance, the incision can be carried down to the subcutaneous fascia with advantage to the viability of the flap and to the rapidity and ease of its manipulation In a fat subject, however, the inclusion of such a quantity would be deleterious to the final result and would make the future of the flap a matter of some difficulty and be of considerable immediate peril to its blood supply A thought occurs to me in regard to blood supply in fat patients that there is only a limited quantity of blood supply to an individual area, which in the presence of the fat is dissipated before it enters the skin Consequently, in obese subjects I would issue this note of warning to be more patiently conservative than in the thin The length of the primary tubing can also be varied according to the actual site from which the flap has been taken Thus a flap in the oblique inguinal region or one more vertically parallel to the main vessels of the abdominal wall can be cut with a greater margin of safety than one which crosses the middle line either above or below the umbilicus or traverses the middle line of the chest Flaps whose base lies in the region of a natural anastomosis such as the acromial can therefore, be cut with confidence

**Sites** The common donor sites are the oblique inguinal, single or double, the vertical abdominal, the acromiopectoral, single or double, the less common sites are the neck, the back of the shoulder, the outer aspect of the arm, and the outer and anterior aspects of the thigh

**Suture** As the skin edges are rolled together there is a tendency for fat to protrude It

Fig 5 Example of branched  
pedicle. The branch is for the  
upper lip, the extremity for the  
nose, and the neck portion for  
the cheek





Fig 6 Example of one pedicle flap (temporal artery) conveying another tubed pedicle (acromial) to the nose

should be trimmed with scissors and as the suture progresses the action of the thumb in advance of the suture will effectually prevent the interpolation of fat between the skin edges. After the flap has been cut and its undersurface carefully examined for bleeding points a decision is made as to how much of the flap can be tubed without undue tension at either end. A fine hook is passed through the skin at the commencing point and the skin of that side dragged through into juxtaposition with the corresponding point on the near side. A first interrupted suture is placed



Fig 8 Acromipectoral flap—special method for nose. Upper right photograph shows acromial end of pedicle attached to palmar aspect of wrist



Fig 7 a Transference of abdominal tubed pedicle to neck via the wrist. Typical method. b The first implant to the neck. c The new neck with an extra piece let into the chin to cure the drag of the mouth





Fig 9 a Severe burn of half the face b, Restoration by abdominal tubed pedicle c, Double temporary attachment to wrist for convalescent purposes d, Artificial eye socket on glasses



Fig 10 Bilateral abdominal pedicle with central attachment to wrist The opportunity was taken of implanting this pedicle into a scar which was present at the base of the thumb



Fig 11 Example of vertical abdominal pedicle including the umbilicus for whole face replacement



Fig 12 Bilateral abdominal pedicle for avulsion of scalp, implantation of both extremities to back of wrist

and held as a stay A similar procedure is adopted at the other end The two edges of skin are now presented to the operator and may be sutured with ease If the flap is to be used in an exposed position it is well to make this suture with a subcuticular stitch, using an eyeless needle At all times avoid damaging the skin with dissecting forceps

Closure of the secondary wound A decision now has to be made as to whether the wound can be closed by direct approximation beneath the pedicle or not, such a closure is usually available in the abdominal wounds as well as in the acromioclavicular Free undermining of the surrounding skin and positioning of the thigh or the arm will materially aid this clo-

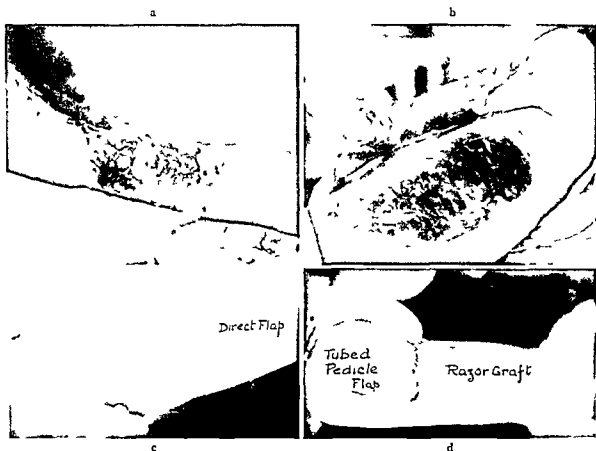


Fig 13 a Loss extending from the upper arm to below the elbow b Repair of inner aspect of arm by direct flap Note the tubed pedicle extension thereof c Showing part

of direct flap d Showing use of tubed pedicle to form elbow skin Razor graft being used for the outer aspect of the arm

sure Deep catgut sutures relieve the tension and interrupted silkworm sutures are placed through the skin

At the place where the tubed pedicle leaves the abdomen at either end will now be found a triangular raw area There will likewise be found a similar raw area in the abdominal wound The apices of the two triangles are approximated by a special suture The needle is passed through the skin of one side of the abdominal edge emerging in the subcuticular area It is continued as a subcuticular stitch first down one side and then up the other of the apex of the tubed pedicle triangle, finally it emerges opposite its entrance at the apex of the abdominal triangle When tied, the two triangles are accurately approximated When there is no possibility of a satisfactory secondary closure the raw area may be left



Fig 14 A huge tubed pedicle flap from outer aspect of buttock and thigh to make skin clothing for damaged leg

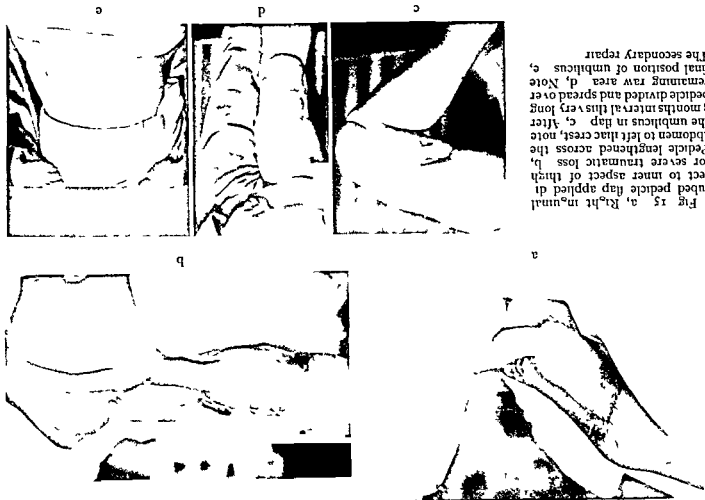


Fig 15. a, Right inguinal tubed pedicle flap applied direct to inner aspect of thigh for severe traumatic loss. b, Pedicle lengthened across the abdomen to left iliac crest, note the umbilicus in flap. c, After 3 months this is very long pedicle divided and spread over remaining raw area. d, Note final position of umbilicus. The secondary repair.

to granulate or be grafted with a free razor graft

There are certain modifications of technique for *very large or very broad* flaps. The size of the amount that may be tubed at the first intervention has already been indicated. If further skin is required the tubing process may be continued at the end of 10 days to a fortnight. The same remarks apply on the occasions when a branch tube is run sideways from the main tube. When the flap is very broad, it may frequently be found advisable to make a square-ended implantation into the forearm as the first stage and to follow this up by tubing the broad flap 14 days later. *Dressing* Further to safeguard the secondary closure the skin is treated with mastisol and gauze applied from side to side beneath the pedicle. Two gauze rolls are now placed parallel to the tubed pedicle to safeguard it from any undue pressure and yet to allow of inspection for the presence of hematoma or the progress of the circulation

#### THE FIRST REMOVE

A pedicle should be examined the same evening and at frequent stages. Any hematoma should be freely expressed, and if the vitality of the flap be endangered for any reason, warm saline dressings should be applied at very frequent intervals. At all stages massage of the flap is of considerable value

For a simple pedicle of not more than 8 inches it should be possible to detach one end after an interval of 3 weeks. This time will have to be increased if there has been any hitch or if the pedicle is of greater dimension. In severing the end designed to be moved first, care must be taken not to include any considerable portion of skin which was not tubed in the first instance and as therefore devoid of an already established longitudinal blood supply. If insufficient of the flap has been "tubed" at the first occasion the extra bit must either be "delayed" or further "tubed" prior to its being cut off. The raw



Fig. 16 Use of thigh as intermediate host for transference of abdominal pedicle to opposite leg

end of the pedicle is now free in the air and is approximated to its next home. When the process is direct such as in an acromipectoral flap to the cheek or nose just so much of the pedicle is opened out as is convenient for the restoration or safe from a blood supply point of view. For instance it is not usually safe to open a pedicle more than half its length. When the free end of the pedicle is to be grafted into an intermediate host as the wrist very little of the pedicle need be opened out say 1 inch.

*The opening out process.* The pedicle flap is held in the hand with the seam uppermost and the extremity of the raw area retracted with fine hooks by an assistant. The seam being kept central a fine knife is used to excise or incise this seam until the pedicle opens out. It is essential that the opening out of the pedicle should be done on the same line as that in which it was closed.

*The blood mark.* A convenient method of design for implanting the open end of the

pedicle is by squeezing it, say, on the back of the wrist to which it is to be attached. This makes a blood mark of the exact size of the raw area of the pedicle. If now half of this blood mark be turned backward toward the pedicle the two areas when sutured together should be approximately equal. Again care must be taken to prevent hæmatoma formation. In addition to tying the vessels it is as well to put in two deep catgut sutures to approximate the fat of the two areas. Care even in this maneuver must be taken also for I have known quite a number of cases in which their presence has constricted the blood supply to part of the flap. Suture of the skin edges of this stage is usually by interrupted, occasionally by blanket, method.

#### SECOND REMOVE

The second of the two original attachments of the flap is now divided. If the pedicle be of reasonable proportion that end of the flap



acromiopectoral or abdominal via the wrist, for such conditions as both sides of the scalp and forehead, the forehead and nose, the cheek and chin or the cheek and upper lip and for a complete neck. On three occasions pedicles have been implanted into another pedicle as its intermediate host a particularly good one being the turned down temporal artery flap attached to an acromial. A most remarkable study in viability of these flaps occurred in a case in which two long pedicles were joined end to end. When one end was finally detached, the circulation from the upper end of the first pedicle was entirely adequate to penetrate through a very poor joining scar right to the extremity of the second pedicle. It is found convenient occasionally to criss cross two pedicles or to cross over the free ends of a long pedicle. These maneuvers are dictated by expediency and opportunism. A special method of making the nose from an acromiopectoral flap is to detach the acromial end and to suture it to the palmar aspect of the opposite wrist in such a way that when the back of the hand is placed on the forehead the pedicle will be hanging straight down the nose with its

joining seam facing backward. Examples could also be enumerated of transferring the pedicle via the wrist to the knee or lower, and of using the opposite thigh as an intermediate host for areas below the knee. One of the longest pedicles I have ever made went from side to side of the abdomen, including the umbilicus. It was "tubed" in two stages, the second stage after the first implantation had been successfully grafted into the thigh. After the second half had been "tubed" the flap extended from the region of the inner condyle of the right femur to the left iliac crest about two thirds of it being in the air. The umbilicus was seen to adorn its middle and eventually to end up somewhere above the knee an unusual place in which to carry the navel.

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#### Discussion

DR CHARLES G. MIXTER, Boston. We are all doubtless familiar with Sir Harold Gillies' work in plastic surgery. His accomplishments in reconstruction of severe facial injuries was one of the outstanding contributions of the War. It was he who popularized the transference of large areas of skin obtained from distant locations by the tube graft method and placed it in the hands of the profession as a most useful procedure. Formerly in my service at the Children's Hospital I had an opportunity of using this method freely and with satisfaction chiefly in the correction of deformities following burns. In large part these deformities occurred in girls due to the inflammable nature of their dresses. Contractures of the extremities, axillæ and in particular the neck, have yielded eminently satisfactory results under this method. In late years the better understanding of the Z method of utilizing the scar tissue web has to an extent supplanted the tube graft, but in broad contracted cicatrices the latter is the method of choice in my opinion.

The use of the tube graft has not been invariably successful in my hands. Echinæmia is the most potent cause of failure. Too great length in comparison to the width of the rectangular flap raised for construction of the tube, too tight suture about the enfolded

subcutaneous tissue and too early transference of one end to its new location are among the causes of diminished blood supply.

In my experience, relief of the broad contracting scars of the neck following burns is most satisfactorily obtained by the tube graft method. The lesion usually occurs in girls and the choice of site from which to make the transfer with a minimum of visible scarring is difficult, as no one can foretell how far the present trend in feminine fashions may ultimately lead its votaries. The lower lateral aspect of the chest wall seems the most suitable situation. In conclusion I should like to express to Sir Harold our sincere appreciation of his brilliant work in this field and thank him for his kindness in presenting his views on the subject tonight.

ERNEST M. DALAND, M.D., Boston. The development of the tube pedicle graft has solved many plastic problems. The speaker has been too modest in regard to his part in the origin and development of this method. It is he who has put it into practice and he who has had the courage to try out new applications for its use.

In selecting a site for the graft it is essential to remember whether the skin used is going to grow hair

or not. If the graft is going to become a living flap for a cheek, it is essential that there be no hair on it. If the graft is to form a covering for a man's cheek it is desirable that there should be hair on it.

Most of us have had cases in which we have used the tube pedicle graft successfully. Some of us have had failures. I wish to point out some of the reasons for these failures.

1 The tube has been made too long in proportion to its width. Sir Harold sets 8 inches for the maximum length, but then only if conditions are ideal. If not a full 3 inches of width is available, the length must be less than 8 inches.

2 The tube graft has been too narrow.

3 Too much fat has been used in the flap. The tube edges should come together without tension. Too much fat will cause eversion of the skin edges. The secondary swelling and lymph stasis will shut off the circulation and the flap will die.

4 Too little fat in the flap will likewise cause trouble. In a patient with no subcutaneous fat, the pedicle method is probably not the best.

5 The flap has been cut too close to the midline or has crossed over the midline. Occasionally a flap should be made slowly and not made too long at the first stage.

6 Infection will produce necrosis and scarring and interfere with the circulation.

7 The dressing may be applied too tight over the tube pedicle flap. This may cause thrombosis and necrosis.

8 The transfer of the flap may be made too early. Three weeks is usually early enough, unless the flap is very short.

9 Finally, in moving the graft to its new position, I find that tissue that has been heavily irradiated makes a very poor host. In fighting the irradiation reaction, all the collateral circulation has been called on. As a result, little circulation goes into the graft and healing, if it occurs at all, is delayed.

If a few of these precautions are followed, I am sure that we shall all be satisfied with the results which we obtain.

PHAGEDENIC ULCERATION—ITS RECOGNITION AND TREATMENT<sup>1</sup>

EMILE HOLMAN M.D. F.A.C.S. SAN FRANCISCO CALIFORNIA

From the Department of Surgery Stanford University Medical School

Φαγε δαίμα canker, Φαγειν, to eat

SINCE Cullen's arresting description of his experience with a particularly stubborn infection following incision of an abdominal wall abscess, presumably appendiceal in origin numerous similar experiences have been frankly and courageously recounted by perhaps somewhat chastened surgeons. The picture is much the same in each instance following drainage of an abscess whether of the abdomen or chest (Fig. 1) there has occurred a slowly but insidiously progressive destruction of the skin before which the surgeon has for a time stood completely helpless baffled because none of the usual and known bactericidal agents—chemical or physical—seemed to have the slightest influence in controlling the infection and served only to strike terror to the patient through their extreme painfulness. No other experience is calculated to be so effectively humiliating nor likely to fill one with a greater sense of futility as to see the precious covering of the body, in spite of anything one may do slowly but surely recede before the relentless advance of invading organisms. They seem literally to "eat" away the skin. The disease is characterized by a remarkable chronicity. Until its final stages it is not fulminating, nor unusually prostrating, following the development and drainage of the initial infection, it is usually not attended by severe constitutional symptoms. But inexorable in its advance and apparently inevitably progressive it is completely demoralizing to a patient who in full possession of all his faculties is subconsciously aware of the helplessness that weighs heavily upon his attending physician. Ordinarily nature is very kind in dulling the sensorium of the acutely and gravely ill patient so that little remembrance remains of a particularly trying period. In this disease the patient shares the apprehension of the doctor, and too often his morale is completely broken. He awaits the dressing with terror and begs to be let alone.

He prefers death to the harrowing experience of the daily dressings. Fortunately, Cullen's opportune rediscovery of the cautery and Baer's courageous application of maggots in combating stubborn infections have provided a very satisfactory way out. The problem is to recognize the lesion and to apply the proper therapy at the right time.

An analysis of the recorded cases reveals some instructive facts. By far the greater number have followed the drainage of intra-abdominal abscesses usually appendiceal in origin. The accompanying table (Table I) presents a brief resume of the recorded experiences. Sixteen cases followed the draining of a ruptured appendix, one case followed a caecostomy for carcinoma of the sigmoid, another followed drainage of a subphrenic abscess complicating a perforated duodenal ulcer, another followed drainage of an encapsulated empyema complicating appendectomy with drainage, another followed drainage of an empyema complicating a pulmonary abscess, one case followed drainage of an empyema complicating pneumonia, one case followed the draining of an abscess of the breast, and one case followed an infection of the abdominal wall in a gardener subject to contact with organisms found in the soil and in fertilizers.

The last named case deserves more comprehensive comment. Luckett in 1909 advocated and performed cautery excision for a spreading phagedenic ulceration of the abdominal wall. The patient was a gardener who had picked a small pustule with his fingernail within 10 days an ulcer  $5\frac{1}{4}$  by  $10\frac{1}{4}$  inches had developed over the abdomen with astonishing rapidity and much pain. Excision of the edges by the Paquelin cautery was followed by prompt healing. The cultures yielded only a *Staphylococcus aureus* both in the aerobic and anaerobic cultures. The hospital pathologist, Dr. Humphreys, made the fol-

<sup>1</sup>Presented in the symposium on the Treatment of Infections before the Clinical Congress of the American College of Surgeons Boston October 15 1934.





Fig 1 Remarkable progressive ulceration of thoracic wall following drainage of empyema complicating a pulmonary abscess (Christopher)

lowing arresting suggestions "In my opinion, the infection probably belongs to the heterogenous class, known as soil or dirt infection, to which belongs chancreoid phagedena, malignancy, etc. The organisms of this class in general are anaerobic spore bearers inhabiting rich soil etc. Owing to the difficulties of artificial cultivation their specific characters are but little known. The staphylococci are probably of only secondary significance." The following 4 cases are added to this growing list of experiences with a slowly but irresistibly advancing infection, which as yet remains somewhat obscure in its origin, which is peculiarly resistant to all forms of therapy, but which yields to caustery debodement, when applicable, and to maggot therapy.

Case 1 M S, aged 25, a single female, while working in a garden, in December, 1930, developed a blood blister on the palm of the left hand. The blister was opened, but was not dressed, and she continued her work with fertilizers and soil without protection of the wound. This healed after temporary soreness, but 2 months later a tender mass appeared in the left axilla, which was incised and drained on February 6, 1931. The culture is said to have yielded a streptococcus. Due to non healing, a second incision was made in April for the evacuation of pus and the removal of necrotic gland tissue. The discharge of pus continued, however, and the wound, instead of improving, grew larger. When first seen on July 21, 1931, 8 months after the beginning of trouble, there was a dirty looking wound about 6 by 4 centimeters with an abscess cavity leading up underneath the pectoral muscle toward the apex of the axilla. The 2 incisions made 3 and 5 months previously were unhealed and discharging pus. The edges of the wound were distressingly painful to all the known antiseptics, most of which had been given a trial and found ineffectual. Direct sunlight, irrigation with 5 per cent salt solution, and the occasional application of Berwick's dye during the next 2 months caused slight but definite improvement. Slow progress prompted admission to the hospital on September 15, 1931. At this time the cells numbered 4,500,000,



Fig 2 a December 10 1931 Appearance of axillary wound 10 months after incision of abscess Note the progressive ulceration below the incision and the secondary ulceration posteriorly b October 4 1933 Complete healing without fibrous contraction

hemoglobin 95 per cent and the white cells 13 600 of which 70 per cent were polymorphs 12 per cent lymphocytes and 8 per cent large mononuclears. Cultures on October 12 from the original wound disclosed a pure growth of hemolytic streptococci.

Under observation an instructive development occurred. Below and posterior to the original wound in an area bathed by pus there appeared a small pustule which looked like an ordinary hair follicle infection. After discharging a central slough or core the resulting wound spread slowly but insidiously through a gradual necrosis of the wound edge until it was 3 centimeters in diameter. Subsequent cultures showed in addition to the hemolytic streptococci the presence of the *Staphylococcus aureus* and a non virulent diphtheroid bacillus. Special cultures from beneath the undermined skin established the absence of anaerobes.

During a 6 weeks stay in the hospital the treatment consisted of forced nourishment rich in vitamins irrigation with hypertonic salt solution and the daily exposure to the quartz lamp. For a few days on one occasion an erysipeloid blush spread forward from the wound over the left breast but subsided rather promptly. The administration of 50 cubic centimeters of anti streptococcus serum produced a violent reaction at site of injection in the left thigh but no sloughing occurred as in the Arthus phenomenon. Following her discharge from the hospital on October 26 1931 the patient underwent treatment of the wound with a bacteriophage for 8 weeks without improvement.

The patient was readmitted on December 18 1931 for the purpose of undergoing treatment with maggots. In the meantime the 2 wounds had spread slowly but gradually through an advancing necrosis of the skin edge (Fig 2). The denuded surface was covered with a dirty looking pus the edges were slightly raised infiltrated and firm undermined for about 4 millimeters and of a dusky bluish discoloration fading through red into the normal color about 1 centimeter from the edge. There was no macroscopic gangrene or necrosis.

One thousand maggots were introduced into the wounds on December 19 1931, and a second lot of 1 000 on December 24. These caused a violent reaction in the tissues, as shown by marked edema and considerable purulent discharge. The temperature rose to 40 degrees C and liberal doses of pantopon alternating with sodium amytal were necessary to keep the patient comfortable. The violent reaction in the wounds the high fever and the great discomfort prompted removal of maggots on December 26. The edema and fever promptly subsided and the wounds showed marked improvement.

On December 31, 1 000 maggots were again introduced into the wounds but removed on January 3. The patient was dismissed on January 6, the wounds looking very much improved.

On March 7 the patient was re admitted because of the persistence of a deep axillary wound. The superficial ulceration posterior to the axillary wound was healed. One thousand maggots were introduced into the axillary wound on March 7 and removed on March 11. Temperature rose to 39 degrees C but dropped promptly on removal of the maggots. The patient was discharged on March 12 and re admitted on April 16 for the fifth and last introduction of maggots. On July 18 19 months after the inception of the infection she reported for observation completely healed.

On September 23 the patient re entered the hospital for a brawny induration of the axillary scar which had followed overexertion of that arm in a tennis game. An abscess broke spontaneously from which both the *Staphylococcus aureus* and the hemolytic streptococcus were recovered. Prompt healing occurred after evacuation of the abscess.

On January 16 1933 the patient re entered the hospital for an exactly similar reaction in the scar following heavy work in the garden. An abscess was incised which again yielded both *Staphylococcus aureus* and hemolytic streptococci. Complete healing followed and no further trouble has developed.

An axillary abscess followed a small blister of the left hand which had been opened and exposed to animal fertilizer. In the original culture only the hemolytic streptococcus was recovered. After 11 months of progressive enlargement of the axillary wound and the development of a secondary ulceration of the chest wall from which the hemolytic streptococcus and the *Staphylococcus aureus* were recovered the wounds were treated by the introduction of maggots on 5 occasions in a period of 4 months. Healing was not complete until 19 months after the initial lesion had occurred.

On two subsequent occasions 2 and 6 months after complete healing had occurred,

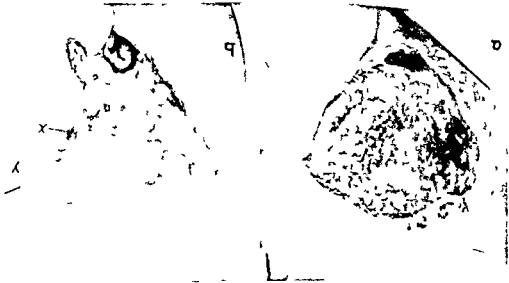


Fig 3 a, September 3, 1932 Progressive ulceration of abdominal wall following simple appendectomy 19 months previously. Note undermining of vulva b, April 26, 1933. Re epithelialization of abdomen by successive skin grafting following cautery debridement Granulating areas still present in both inguinal regions involving femoral vessels x. Site of erosion of left femoral artery y. Site of incision for ligation of external iliac artery on April 3, 1933

the trauma of effort initiated an abscess in the healed scar, from which organisms were obtained exactly similar to those presumably responsible for the initial lesion. In spite of the presence of both these organisms, healing occurred without delay following evacuation of the abscess

Case 2. M W, aged 42, housewife, was operated upon February 6, 1931, for a fixed pelvic mass, which was found to be an ectopic kidney. An appendectomy was performed through a lower midline incision. This incision broke down, the edges became undermined, and despite numerous and varied forms of treatment, a gradually increasing ulceration of the abdominal wall developed. This treatment included irrigation with hypertonic salt solution, Dakin's solution, hydrogen peroxide, mercuric chromic, the administration of potassium iodide and salvarsan, the use of the quartz lamp, sun baths, a staphylococcus streptococcus bacteriophage, maggot in the wound, transfusion from an immunized donor, and a high vitamin diet.

On December 30 an incomplete cauterization of the wound with excision of overhanging edges of skin was performed, and again on February 5, 1932 Gradual extension of the ulceration occurred, however, until the patient was admitted to the Stanford Hospital on September 2, 1932, 17 months after a simple appendectomy and the inception of the infection.

On admission, the patient looked drawn and pale. She was exceedingly apprehensive, and fearful of what would be done to her very painful wound of Her temperature was 38.5, pulse 120, respirations 22,

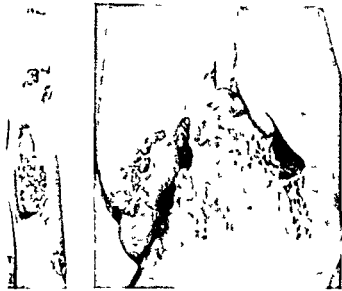


Fig 4 Case 2 August 16, 1934 a, appearance of wound 3 1/2 years after inception of infection. Note increased involvement of both inguinal regions, resulting finally in a fatal hemorrhage from the right femoral artery. b Progressive ulceration of left lower leg following abscess of heel due to infected arterial embolus incident to ligation of left femoral artery



Fig 5 a September 6 1933 Appearance of axillary wound 7 months following evacuation of abscess secondary to abrasion of finger b Appearance of secondary lesion above elbow showing the characteristic appearance of oedematous granulation tissue in center and undermining of coloration and necrosis of skin edges

mined for 4 to 6 centimeters. The flap of skin and subcutaneous tissue overlying the undermining was in certain areas 2 centimeters thick. The undermining process extended well under the labia.

A blood culture was negative. The cultures of the wound showed the presence of *Staphylococcus aureus* haemolytic streptococci (beta Brown) and partially haemolytic streptococci (alpha prime Brown). Cultures from beneath the undermined skin on specially prepared media established the absence of anaerobes and fungi.

On September 9 1932 an extensive cautery debridement of the wound was performed by excising all areas of overhanging skin. The labia were almost entirely removed. The surface of the wound was lightly touched with the hot cautery. A disheartening feature was the extension of the infection into the region of the femoral vessels in both groins thus preventing cauterization of the wound in these areas. A transfusion was given at the end of the operation.

On September 13 the red cells numbered 4,280,000 haemoglobin 53 per cent white cells 12,000 82 per cent polymorphs (70 banded, 12 segmented). On September 29 the white cells numbered 9,100, polymorphs 64 per cent (banded 17 per cent, segmented 47 per cent). Under saline and Dakin's irrigations the wound improved and on October 4 the first skin grafting was performed. 82 small deep grafts being applied to the granulation surface. On October 23, 132 more grafts were applied, and on November 5 93 more were applied.

A high fever for 3 days on December 19 to 22 led to a blood culture which was positive for *Staphylococcus albus*. A blood culture in a week's time again yielded the same organism. The fever then subsided. A transfusion was performed on January 4 1933 from an immunized donor. More skin grafts were applied on January 15.

By February 16 the abdomen was epithelized but there was considerable undermining of the skin of the left thigh extending down from a sinus tract immediately over the left femoral vessels. This overhanging undermined skin was excised on February 16 followed on March 7 by skin grafting.

On March 27 began a series of episodes which eventually led to death 1½ years later. Within 3 days several massive haemorrhages occurred from an aneurysmal erosion of the left femoral artery. On April 1 a transfusion was given. On April 3 the left external iliac artery was ligated through a clean area above the left superior iliac spine, following which all bleeding ceased. A transfusion was given at the end of the operation. April 13, transfusion. April 26 transfusion. May 2 transfusion. On May 4 the haemoglobin was 76 per cent.

On May 21 though not completely well the patient returned home at her own request. Small discharging wounds were still present in both groins over the femoral vessels. The patient was instructed to take baths in hypertonic salt and in the sun.

In August all teeth were removed for multiple abscesses.

The patient was re-admitted December 16 1933 for excision of undermined skin surrounding many sinuses in the left inguinal region. The red cells numbered 4,000,000 haemoglobin 85 per cent white cells 20,120 79 per cent polymorphs (73 per cent banded 6 per cent segmented). Cultures at this time yielded the *Staphylococcus aureus* a diphtheroid bacillus, the *Bacillus subtilis* and the haemolytic streptococcus. On December 27 maggots were introduced into both inguinal wounds, but for some reason they refused to remain in the wounds. The pabulum was apparently not to their taste. On January 26 repeated massive haemorrhages from the site of the former erosion of the left inguinal artery necessitated ligation of the artery and division between ligatures. Cultures at this time showed a growth of *Staphylococcus aureus* haemolytic streptococcus (beta Brown) and *Bacillus pyocyaneus*. Unfortunately, the ligation of the artery had to be done in a pus soaked field and immediately after

the operation the patient complained of a painful heel. On March 21, 2 months later, a small abscess was opened on the heel, which was apparently precipitated by an infected arterial embolus at the time of the above ligation. Cultures from this secondary abscess showed a growth of the haemolytic streptococcus only. The entire left leg was greatly swollen and showed a marked glossy oedema over the thigh, leg and foot. April 14, 1933, transfusion. On May 18, excision of undermined skin and sloughing Achilles tendon on left was performed. The left foot was practically useless.

On June 4, the red cells numbered 4,600,000, haemoglobin 58 per cent and white cells 12,000. 86 per cent polymorphs (10 per cent banded, 76 per cent segmented), 12 per cent lymphocytes.

On June 6, excision of the undermined skin of the left calf and of the advancing necrosis of the Achilles tendon was repeated, July 5 further excision of undermined skin of the left calf, it had now reached the knee along the intermuscular septa.

On July 8 a massive haemorrhage occurred from the right femoral artery, which was temporarily controlled by pressure. On July 31 another exsanguinating haemorrhage necessitated the ligation and division of the right femoral artery and vein. Transfusions were performed on August 2, August 6, and August 10. On August 12 a markedly firm oedematous swelling of both thighs and legs developed (Fig. 4). Death occurred on August 17, 3 3/4 years after the beginning of the infection.

In spite of heroic efforts to control an infection which began in an abdominal wound following a simple appendectomy, no head-way was ever made in the region where the infection had invaded the inguinal glands and vessels. A bacterial destruction of the left femoral artery resulted in exsanguinating haemorrhages for which the left external iliac artery was ligated. Months later the same vessel again burst forth with terrifying haemorrhages for which the femoral artery itself was ligated and divided at the site of bleeding. Severe massive haemorrhages from an eroded right femoral artery finally resulted in death. Although the haemolytic streptococcus and the Staphylococcus aureus were always recovered from the original wound, only the streptococcus was recovered from the abscess initiated in the left foot by an infected arterial embolus following ligation of the left femoral artery in a pus-soaked field. This secondary lesion spread slowly but insidiously up the leg, with gradual undermining of the skin and involvement of the underlying Achilles tendon and calf muscles.



Fig. 6, a, September 30, 1933. Appearance of axillary wound showing its great depth following cautery debridement and introduction of maggots. b, Appearance of lesion on elbow following wide excision of its undermined areas, 23 days previously.

The case provided certain very striking lessons first, the need of early recognition of the irresistible character of the infection if not properly treated, and second, the need of

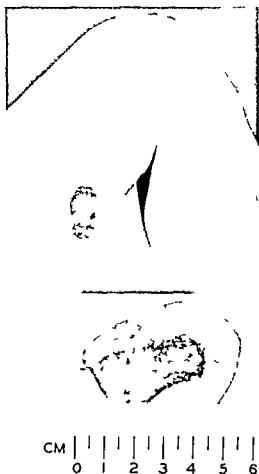


FIG. 9. a Case 4. Phagedenic ulceration of thigh of 3 weeks duration following careless picking of small pustule. Patient was a plumber. Healing after 2 months by excised specimen consisting of base and overhanging edges of ulcerated skin.

excellent functional result. Contractures in the axilla were minimal in spite of a wide spread and deep seated infection due it is believed to the control of infection without fibrous reaction through the use of maggots. Until healed the wound on repeated occasions yielded the 2 organisms the hemolytic streptococcus and the *Staphylococcus aureus*.

CASE 4. C. P. J. aged 48 plumber considered himself perfectly well until 2 weeks before admission to Stanford Hospital on July 25, 1934 when he had picked a small pustule on the inner side of his left thigh with an ordinary pin. No dressing was applied, and within a day a sore swollen area developed, followed in another day by ulceration, which has spread rapidly since. The ulcer has been very painful and has discharged considerable pus. Ten days

after the onset, the glands in the left groin became swollen and painful.

The patient's occupation as a plumber necessitated contact with sewage, and the frequent wearing of rather dirty sewage soiled trousers.

On admission the examination was negative except for a dirty ulcer on the inner surface of the left thigh, about 3 by 6 by 0.5 centimeters in size the edges of which were undermined and of an angry bluish red appearance. Redness and induration extended beyond the edge on all sides for about 1 to 2 centimeters (Fig. 9). A tender mass of glands was easily palpable in the left groin.

The blood pressure was 160 systolic 90 diastolic the red cells numbered 4,800,000 the white cells 8,500, with 78 per cent polymorphonuclears and 20 per cent lymphocytes hemoglobin 86 per cent urine, normal Wassermann reaction negative. A culture from beneath the undermined edge showed hemolytic streptococci of the beta Brown type and a few colonies of *Staphylococcus aureus*. Anaerobic cultures established the absence of anaerobes. The basal metabolic rate on July 27 was minus 23 per cent. The blood sugar was 107 milligrams per 100 cubic centimeters.

On July 28 the entire ulcer, including the overhanging edges and the dirty base was excised with a radio cautery (Fig. 9). The microscopic section revealed only chronic inflammatory tissue.

Following debridement of the wound 25 small deep grafts were applied to the clean looking ulcerated surface on August 9. Only four "took" and these later sloughed off. Also on August 16, 32 additional grafts were applied, but again all but seven were floated off in a sea of pus.

In spite of the administration of 2 grains of thyroid daily the basal metabolic rate on August 23 was minus 25 per cent.

Under active debridement, the wound gradually cleared and the patient was discharged September 2 with the edges slowly growing in. By September 23 complete healing had taken place.

The important points of interest in connection with this case are (1) the occupation of the patient, which requires contact with sewage, (2) the presence of both the streptococcus and the staphylococcus in the wound, though neither was anaerobic in character, (3) the low basal metabolic rate, (4) the slow but steady healing that occurred following cautery debridement of the ulcer, which had given promise of being an insidiously progressive lesion.

#### EXPERIMENTAL DATA

Two dogs were injected with organisms obtained from Case 2. The hemolytic streptococcus was injected subcutaneously in the left flank, the *Staphylococcus aureus* in the

this type of infection, and his hypothesis that it is due to a bacterial synergism, a symbiotic phenomenon involving the two organisms, has found ready acceptance. Little corroborative evidence is to be found in the recorded cases due to lack of uniformity in the bacteriological studies made, and due to the great variety of organisms recovered from the lesions. In the cases here presented two organisms were invariably found, but the streptococcus recovered was hæmolytic and aerobic.

Moreover, in the recorded cases, Christoper, Cullen, Shipley, Poate, Ballin and Morse, Carol, and Horsley report the recovery of only the hæmolytic streptococcus from the wounds of their patients, and in two instances—Luckett, and Probstern and Seelig—only the staphylococcus was recovered. Of more than usual interest in a group of patients reported by Stookey, Ferns, et al, who observed as a complication of erysipelas the development of necrotizing ulcers, from which a pure culture of staphylococcus aureus was obtained. The necrotizing factor they attributed to a bacteria-free filtrate, presumably an exotoxin, recovered from cultures of this staphylococcus. When this filtrate was injected intracutaneously into the skin of a rabbit, necrosis invariably occurred, although filtrates from the Streptococcus erysipelas and from a Staphylococcus aureus recovered from a furuncle, yielded no such necrotizing element. The authors postulate a specific staphylococcus possessing dermonecrotic properties.

Our animal experiments with attempts to reproduce the lesion by inoculation of two organisms singly and in combination, corroborate Alkeny's observation that two organisms together produce more pronounced lesions than single organisms, but in no instance were we, or Alkeny, able to reproduce the progressive lesion seen in the human cases. Experiences such as these almost force one into that mysterious wilderness of medical knowledge, the realm of the highly enigmatical state to infection and the highly enigmatical state may exhibit extraordinary and highly individualistic qualities under different conditions.

right flank, and an emulsive mixture of the two at the xiphisternum. In each instance a definitely more pronounced reaction occurred at the xiphisternum than in the flanks, with central sloughing at the site of injection over a very limited area. Prompt healing followed the spontaneous evacuation at the site of sloughing of a small amount of thin pus.

In a third dog a remarkable gangrene of the skin and muscles of the chest wall occurred, causing the death of the animal in 3 days, but cultures of the pus revealed, in addition to the streptococcus and staphylococcus, the presence of Welch's bacillus.

In 2 other animals the Staphylococcus aureus obtained from Case 4 was injected first, causing a mild reaction. At the height of reaction, the hæmolytic streptococcus obtained from the same case was injected at the same site. The reverse order was attempted in another animal, but in each instance no gangrene nor spreading infection occurred.

A sixth animal was similarly injected with the organisms recovered from Case 3, namely, an aerobic streptococcus and an anaerobic staphylococcus, without producing any lesions other than small abscesses which healed promptly.

#### DISCUSSION

Four cases are presented, exhibiting the characteristic features of the progressive and relentless bacterial ulceration of the skin and subcutaneous tissues described in the literature most commonly as a complication following operation for a ruptured appendix. In reviewing the recorded cases one cannot escape the inference that some intestinal organism or organisms are in some way responsible for these remarkable infections. In the 4 cases reported here, 1 followed an appendectomy, 2 followed the draining of ailiary abscesses secondary to lesions of the hand—I incurred while handling animal fertilizer, the other incurred while grating carrots, a product of the field, and the fourth occurred in a plumber whose clothes were habitually soiled by sewage.

Alkeny's cases have invariably yielded in culture a non-hæmolytic, micro-aerophilic streptococcus, which together with the Staphylococcus aureus he considers specific for

TABLE I—RECORDED CASES OF PROGRESSIVE ULCERATION

Author	Patient Sex Age	Source	Duration	Organisms recovered	Treatment
Luckett 1909	M 45 (Gardner)	Pustule of abdomen	3 weeks	Staphylococcus aureus	Cautery
Christopher 1914	M 64	Empyema (lung abscess)	81 days	Anaerobic streptococcus Bacillus coli Green forming strep	Cautery Transfusions
Cullen 1924	M 50	Appendiceal abscess	5 weeks	Streptococcus brevis	Cautery
Majeda 1926	M 35	Appendiceal abscess	4 months	Streptococcus Staphylococcus Bacillus coli	Numerous antiseptics and light therapy Cautery
Brewer and Meleney 1926	M 12 M 64	Appendiceal abscess Appendiceal abscess	13 weeks 11 weeks	Var. of organisms Hemolytic staphylococcus Anaerobic non hemolytic streptococcus Diphtheroid bacillus	Cautery Cautery (twice)
Alexander 1926	M 53	Appendiceal abscess	18 months	Hemolytic streptococcus Staphylococcus	Antiseptics Light therapy Burnt itself out
Gillespie 1928	M 39	Appendectomy	11 months	Staphylococcus Gram + diplococci Streptococcus	Salvarsan M.I. Chemicals Cautery
Stapley 1928	?	Appendiceal abscess	4 months	Non hem. strep.	Antiseptics Cautery
Probstern and Seelig 1928	F 35	Abscess of breast	9 months	Staphylococcus aureus Pure culture	Multiple incisions Amputation breast 6 transfusions from immunized donors
Cole and Henderson 1929	M 54	Appendiceal abscess	6 months	Hemolytic streptococcus ? Amoeba	Antiseptics Radiant therapy Cautery
Poste 1930	M 36	Thoracotomy for empyema complicating pneumonia	6 months	Streptococcus	Death after 6 months
Hellstrom 1930	M 54	Appendiceal abscess	3 months	Bacillus coli gram negat. + Bacillus	Numerous chemicals Cautery
Lynn 1931	M 67	Appendiceal abscess	1 month	Streptococcus Staphylococcus aureus	Cautery
Ballin and Morse 1931	M 54 M 57	Empyema complicating labor pneumonia Appendiceal abscess	11 months 4 weeks	Streptococcus Anaerobic strep Diphtheroid bacillus	Repeated excision Cautery
Meleney 1931	M 15	Intra abdominal abscess + appendiceal	51 days	Microaerophilic non hem. strep Hemolytic Staph. aureus	Cautery
Carol 1932	M 62	Appendiceal abscess	4 months	Streptococcus Bacillus coli	Many antiseptics Cautery Death from exhaustion
Baker and Terry 1932	M 51	Appendiceal abscess	7 months	Non hem. strep. Hemolytic staphylococcus	Many antiseptics 12 blood transfusions Cautery Death from endocarditis
Horsley 1932	M 45	Appendiceal abscess	2 1/2 mo	Streptococcus Gram + diplococci Gram - bacilla	Cautery
Patterson 1932	M 6	Empyema complicating perforated appendix	12 months	Hemolytic staph. Microaerophilic strep	Numerous antiseptics Cautery (twice)
Meleney 1933	M 6 F 62 M 57	Carcinoma sigmoid Appendiceal abscess Perforated duodenal ulcer Subphrenic abscess	17 days 70 days 14 days	Anaerobic non hemolytic strep. Staphylococcus Bacillus proteus Non hem. microaerophilic Streptococcus Staphylococcus Bacillus proteus Microaerophilic non hemolytic strep. Hemolytic Staphylococcus aureus Staphylococcus albus	Excision Excision Excision



In our fourth case, efforts to study the factors of individual resistance resulted in an unusual finding. The patient on two occasions showed a basal metabolic rate of minus 23 and minus 25 per cent. Case 3, when on the road to recovery, however, showed a normal metabolic rate of plus 7 per cent. No deductions may be made on the evidence available in treating such infections every effort should be made to increase the resistance of the host to infection. This may be accomplished by transfusions, by sun baths, and by a high vitamin diet, augmented by cod-liver oil and vitamin B. The case of Frobenius and Seelig responded promptly and decisively to blood transfusion from immunized donors.

Locally, the resistance of the host to the infecting organisms was affected in our axillary abscesses by the introduction of maggots, which, according to Baer's unique and highly original observations, remove, by ingestion, necrotic and near necrotic tissue, and change the hydrogen-ion concentration of wound secretions toward the alkaline side—two factors destined to reduce the propagation of the infecting organisms by rendering the local conditions unfavorable.

In adopting maggot therapy, two precautions must be observed: (1) Adequate medical attention, such as morphia, pantopon, or sodium amytal, should be employed every 2 hours in control pain. (2) Maggots must be used in sufficient number so that every part of the wound is being attacked simultaneously.

The success of the debridement lies in carrying the incision bodily and counteraggressively through absolutely healthy skin and subcutaneous tissues, and abolishing all pockets where pus may accumulate and stagnate. There must be no hedging in this procedure all overhanging tissue *must* be removed. It is possible that poor pockets or pouches of pus exhaust the defensive mechanisms of the body, and, once these pockets are removed, the defensive forces may gain the ascendency. In this connection it is interesting to note the reaction of the polymorphonuclears to the extensive infection in Case 2. On the patient's first admission, in the presence of an advanced infection, the white cell numbered 15,550. 82 per cent polymorphonuclears, 47 per cent banded, and 35

## SUMMARY

Four cases of progressive bacterial ulceration of skin and subcutaneous tissue are presented, one cured by maggot therapy alone, one by cautery debridement and maggot therapy, and one by cautery debridement alone. A fourth case succumbed following repeated massive hemorrhages from eroded femoral arteries, in spite of repeated debridement, which were ineffectual due to the involvement of the femoral sheath.

Eleven days later, 4 days per cent segmented after an extensive debridement, the white cells numbered 12,000. 82 per cent polymorphonuclears, 70 per cent banded, 12 per cent segmented. Thirteen days later, when the suppuration was under much better control, the white cells numbered 9,100. 64 per cent polymorphonuclears, 17 per cent banded, 47 per cent segmented.

On the second admission, again in the presence of marked suppuration, the white cells numbered 20,120. 79 per cent polymorphonuclears, 6 per cent segmented. On June 4, still in the presence of widespread suppuration, the white cells numbered 12,000. 86 per cent polymorphonuclears, 10 per cent banded, 76 per cent segmented. Death occurred on August 17. On the first admission, the observations might have been considered significant, the later studies were contradictory. It seems very unlikely, from the fatal outcome in Case 2, that the deep-seated axillary abscesses in Cases 1 and 3 could have been successfully treated without recourse to maggot therapy. Complete cautery debridement and the abolition of all pockets was obviously impossible. Only maggots could cope with the dirty deadematous granulation tissue, containing numerous organisms, which extended in each instance to the very apex of the axilla. One unexpected advantage resulting from the maggot therapy was the kindly healing that occurred in both axillary abscesses without permanent cicatricial contractions. Full range of motion is now present in both of the patients with deep axillary abscesses recorded here, attributable, it is believed, to maggot therapy. In treating axillary abscesses it is important to support the arm in the abducted position by means of the Balkan frame.

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## Discussion

DR EDWARD D CHURCHILL Boston When a scientist asks for a frog to use for a crucial experi ment he expects to be given a frog and not an animal that may be a frog To obtain consistent bacterio logical findings to support a theory as to the causa tive agent of a disease the clinician must first of all be certain that his cases are all examples of a single disease entity There is real difficulty ahead in at tempting to assign a specific etiological agent to as variable and protean a disease as chronic progressive superficial ulceration Although our bacteriological technique may be exact, we start with an inexact clinical diagnosis These ulcerations that Dr Hol man has described have many manifestations that are the same as those seen in a group we have studied at the Massachusetts General Hospital The cases correspond to Dr Meleney's group and to many other cases reported in the literature but the clinical identity may well not check with the bacteriological identity We have found by animal inoculation that the microaerophilic streptococcus and staphylococcus recovered from many of these ulcers do appear to represent the disease more nearly when injected as a mixed culture than when injected singly However the confusion in nosography rests as much on clinical findings as on bacteriological analysis

Fortunately the proper treatment may be carried out irrespective of these uncertainties as to etiology

The prompt recognition by surgeons of the fact that superficial ulcerations anywhere upon the body may be relentless in their progression and fail to respond to any of the usual surgical methods of control is important If they are correctly treated at an early stage months or years of invalidism or a final fatal termination may be prevented

I have found personally that an excision of the margins of these ulcers with the electrocautery knife followed by skin grafting is the most effective method of control It is only effective however, if the ulceration is still so limited that it may be ex cised I have lost a case that extended into the perineum and the femoral sheath I have lost a second case that started as a simple breast abscess but at the time the condition was recognized involved over one half of the entire chest and abdominal wall and was complicated by sinuses extending under ribs that had previously been resected We have cured at least 7 patients in whom the lesion although ex tensive in some instances could be radically excised

I believe that the ulcer Dr Holman has described is essentially a disease of the subcutaneous tissue and that its manifestations vary in different portions of the body depending upon the thickness of this layer The skin melts away following the destruction of its blood supply through the undermining infection In abdominal cases the umbilicus is usually left at

been treated for a year with sunlight therapy under a diagnosis of tuberculosis suggested by the con-  
dence that the ulceration followed the removal of a  
tuberculous pyosalpinx. During this year the patient  
watched the steady progression of the ulcer until it  
extended from above the umbilicus to the pubes and  
from one iliac crest to the other. To gain the con-  
fidence of this patient it was necessary to delay oper-  
ative procedures for 3 weeks and build up her morale  
by occupational therapy and psychiatric consulta-  
tion. Even when completely healed this individual  
was forced to spend over a year in a mental insti-  
tution to recover from the effects of the disease.  
Surgeons must recognize the true nature of these  
ulcerations at an early date if such serious complica-  
tions are to be avoided.

the apex of a peninsula because of the lack of sub-  
cutaneous fat beneath it. On the dorsum of the  
hand the skin may actually gain a new blood supply  
and remain viable in the center as the active process  
extends peripherally.  
A very important aspect of these cases that Dr  
Holman has stressed is the mental attitude of the  
patient. Many of them have been treated by a series  
of doctors, each one of whom promises relief at the  
outset only to find himself faced with defeat after  
the unsuccessful use of one or more new methods of  
treatment. The exquisite pain of repeated surgical  
dressings breaks the morale of the most phlegmatic  
individual. Most of these patients accept further  
treatment with reluctance or with a complete lack  
of confidence. I recall vividly one patient who had

SOME REMARKS ON THE GIANT CELL TUMOR OF BONE<sup>1</sup>

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THE tumor, known under the various titles of giant cell tumor, myeloid sarcoma, or osteoclastoma, is somewhat of a clinical enigma to the practical surgeon of today. There are three main reasons for this state of incertitude: (1) the tumor can no longer be regarded as a histological entity—a fact which has an important bearing on the problems of diagnosis and treatment, (2) the tumor is rare and its clinical behavior variable, and (3) in the treatment of the tumor, there appears to be a tendency to substitute some form of irradiation for early surgical intervention.

## THE IDENTITY OF THE GIANT CELL TUMOR

To the surgical generation which immediately succeeded Paget (1853) and Nelaton (1860), the myeloid sarcoma, as it was then usually called, appeared securely established as a clinical and histological entity. It was sufficient merely to emphasize the distinctions between it and the true sarcoma of bone. Until the advent of von Recklinghausen's classical description of generalized osteitis fibrosa (1891) this conception remained unchallenged. But with the ultimate widespread recognition in more recent years, that typical osteoclastomata can almost invariably be found in the varied histological pattern which characterizes the osteitis fibrosa group of lesions, the separate identity of the giant cell tumor is now by no means so obvious. For here is the seeming paradox of a histological picture shared by two lesions generically opposed, on the one hand, a true tumor of bone—an osteoclastoma—which behaves in every particular as a neoplasm, and, on the other, a dystrophy of bone, admittedly non neoplastic, which exhibits a striking tendency toward spontaneous healing. For the moment we are concerned only with one clinical type of osteitis fibrosa—the solitary bone cyst.

The outstanding differences between the clinical picture of the bone cyst in children and the giant cell tumor in the adult are fa-

miliar to all surgeons. Some of the main points relating to age and sex incidence, skeletal distribution, site of origin, and clinical course, are conveniently summarized in Table I.

TABLE I

	Solitary bone cyst	Giant cell tumor
Age	5—15 (under 20)	20—35 (over 20)
Sex	M > F	F > M
Site of Election	Humerus Femur Tibia Upper end Trochanteric region Upper end	Femur Tibia Radius Upper end Lower end
Site of origin	Metaphyseal	Epiphyseal
Clinical course	Trauma → Fracture Spontaneous healing + +	(Trauma) → pain → tumor Invasive and destructive

Geschickter and Copeland (2), for whose work on this subject I have the greatest admiration, believe the average bone cyst to be a giant cell tumor which has either already healed or is in process of healing. These authors also recognize as histological entities (a) a giant cell variant of osteitis fibrosa, and (b) a spindle cell variant of the giant cell tumor. These hybrid lesions, which have been described by Geschickter and Copeland more especially in the cysts of the miniature long bones, form a connecting link between the cyst at one end of the scale and the giant cell tumor at the other.

I would urge that the significance of the histological kinship between the cyst and the giant cell tumor be not unduly stressed. There is a danger that this fascinating argument, if carried too far, may tend to disturb the clinician's sense of perspective, and lead, not only to hesitancy in diagnosis, but—most important of all—to delay and imprecision in the treatment of the giant cell tumor. It is far wiser, in my judgment, that we should continue to emphasize the complete independence, as clinical and pathological entities, of the two lesions under consideration. By so doing we are able to formulate principles which will determine the rational treatment of the giant cell tumor. For whereas a cyst may often be treated at leisure by conservative methods, I

<sup>1</sup>Presented before the Clinical Congress of the American College of Surgeons, Boston, October 15, 1934.

the naked eye of a giant cell tumor. The lesion showed well marked invasive qualities but was cured by curettage and cauterization.

CASE 2 Female, aged 23 years. Cyst of femur, lower end, left.

The symptoms were of 9 months' duration and consisted of pain in the left knee, followed by the appearance of a lump on the inner side of the thigh which rapidly increased in size, no trauma, severity of pain a striking symptom.

Examination revealed a localized bony expansion of the left femur just above the inner condyle, tender on deep pressure.

X-ray examination disclosed an eccentric multilocular expansion involving the lower part of the shaft of the femur immediately above the inner condyle. The site of origin was the *metaphysis*, the bony style. The site of origin was the *metaphysis*, the bony expansion was attenuated on the superficial aspect and absent in places (Fig. 3).

Operation on December 11, 1931, amputation as done through the middle third of the thigh.

Description of specimen. The cyst was almost completely empty, except for the presence of a small amount of clear fluid, the interior was lined with patches of tissue, lightly adherent to the bony shell, the greater part of the cyst wall was friable and presented the maroon color of a giant cell tumor.

Histological examination of the cyst lining revealed a fibrous tissue and spindle cell background containing typical giant cell tumor areas, the giant cells were in moderate numbers, large, and contained many nuclei (Fig. 4).

Result. Three years later, the patient is well, wearing an artificial limb and following her occupation.

This is also to be regarded as an atypical bone cyst of the osteitis fibrosa group. True to type, the lesion originated in the *metaphysis*, but was eccentrically placed, after the manner of a giant cell tumor of the epiphysis. The age of the patient, the rapidity of growth, and the radiographic appearances, are also reminiscent of giant cell tumor. Owing to the size, position, and rapid growth of the cyst, it was considered unsuitable for treatment by curettage. Local resection was also rejected, as involving a mutilating operation with a long postoperative period of disability. The patient herself was anxious to return to her occupation at the earliest moment and eagerly concurred in the suggestion of amputation.

I believe that a cyst which runs an atypical course—as in the examples quoted above—like the proverbial leopard, does not really "change its spots." Such cysts are neither

am of the opinion that, with certain exceptions, a giant cell tumor should without delay be eradicated by appropriate surgical measures.

Despite the underlying histological unity between the two lesions, when compared with the typical bone cyst the ordinary giant cell tumor is quite obviously a definitive clinical entity. But solitary cystic lesions of bone from time to time present themselves, which do not conform exactly to type and which, at first sight, might be legitimately mistaken for giant cell tumors. These are cysts exhibiting rapid growth with perforation of the bone shell, after the manner of a true tumor and generally occurring in young adults. Such cysts may contain blood in addition to fibrous lining to the cyst wall, this tissue is not easily distinguishable, on naked eye appearances, from true giant cell tumor material in older individuals. The two following cases from my own collection illustrate some of the uncertainties which may arise in this connection.

CASE 1 Female, aged 15 years. Cyst of pubis, left.

The symptoms, pain in left groin and intermittent limp, had been present 3 months. There was no trauma.

Examination revealed a swelling along the brim of the pelvis on the left side.

X-ray examination showed expansion of the body of the pubis and pubic ramus on the left side with partial disappearance of the ramus (Fig. 1).

Operation consisting of curettage and cauterization of the cyst was done October 29, 1923. The bony capsule was discovered which formed the wall of a large cyst containing blood and masses of tumor like tissue. *See hemorrhage as experiment*, which necessitated temporary packing and the contents of the cavity were evacuated and the interior cauterized with pure carbolic acid.

Histological examination revealed an active cellular picture, consisting of round and spindle cells with well marked giant cell areas, giant cells scanty but large with many nuclei, areas of osteoid bone and hemorrhages.

Result. Complete obliteration of the cyst with reformation of pubic ramus (Fig. 2).

A rapidly growing cyst of the osteitis fibrosa group in an unusual site and containing liquid blood and tumor-like tissue, was suggestive to

hybrids nor atypical giant cell tumors. It seems logical to look upon them as true bred cysts of the osteitis fibrosa group, in which an unusually active tissue proliferation has resulted in bone destruction. Indeed, the problem of the rapidly growing cyst in the adult has even wider implications. For it is well known that benign cysts eccentrically placed at the end of a long bone, and packed with actively proliferating spindle cell tissue, have not infrequently been diagnosed as sarcomata and treated by amputation of the limb. We may, therefore, conclude that the occasional tendency of a bone cyst to run amuck and assume tumor-like activities, does nothing to invalidate the position of the giant cell tumor as a neoplasm *sui generis* and as an independent clinical entity.

#### CLINICAL ATTRIBUTES OF THE TUMOR

One of the most striking facts about the giant cell tumor of bone is its undoubted rarity (I am excluding for the moment the common periosteal *epulis* of the jaw, which lies outside the clinical problems under consideration). It has been estimated that the average yearly quota of giant cell tumors of the long bones in the larger general hospitals of Great Britain is not more than one tumor per year per hospital (Stewart, 6). It is evident that the majority of hospital surgeons do not enjoy a continuity of experience which enables them on every occasion to deal authoritatively with a tumor which makes so infrequent an appearance. In this generation, however, the surgical profession has the inestimable advantage of being able to turn to the wealth of knowledge made available by the intensive study of bone tumors on an unprecedented scale in the United States of America. Every surgeon who is continuously interested in this problem must feel impelled to voice his lasting indebtedness to four great pioneers in this effort: J. C. Bloodgood, E. A. Codman, W. B. Coley, and J. S. Fwing.

A contemplation of the giant cell tumor in its various guises would seem to warrant a recognition of three clinical types—(1) the indolent, slowly growing tumor, (2) the active, rapidly growing tumor, and (3) the rare, malignant tumor. At the same time one cannot

escape the impression that no two tumors behave alike.

1 *The indolent tumor* The indolent tumor is characterized by a very slow rate of bony expansion over a considerable period of time. Its relatively feeble invasive and destructive qualities are made manifest (a) in the roentgenographic picture of a thick bony wall and coarse trabeculation, and (b) in the histological picture by the presence of considerable areas of fibrous tissue. This histological type of giant cell tumor was well known to the older pathologists, who regarded the fibrous tissue reaction as an attempt on the part of the tumor to undergo spontaneous healing (Ribbert).

Indolent tumors have formed a very small proportion of my own series of giant cell tumors and, as it happens, they have all been growths of the lower end of the femur in individuals under 30. I do not attach any importance to the question of site, but I believe the age factor is significant and that slowly growing tumors endowed with very feeble powers of invasion are exceptional after the age of 35.

2 *The active tumor* The active, more rapidly growing tumor, showing well marked invasive and destructive qualities, seems to represent the giant cell tumor in its true colors. The clinical picture is a familiar one. With symptoms of comparatively recent origin, the "tumor" is already appreciable on clinical examination, and is known to be steadily increasing in size. The bony shell, as depicted in the roentgenograms, is attenuated and already perforated at one or more points. The microscopic picture is characterized by a profusion of giant cells, embedded in a background of actively growing cells, both of the round and spindle type.

The active type of giant cell tumor is met with in the young adult as well as in individuals approaching middle age or even later, and its behavior does not appear to be determined by its selection of site. The more one has to do with the giant cell tumor, the more one is impressed by its invasive and destructive qualities, especially in individuals over 30. It is because of such activities that I am accustomed, when teaching students, to refer to



Fig 2 Case 1 The roentgenogram shows reformation of the pubic ramus 4 y ears after the operation of curettage and cauterization

perforation a tiny clump of tumor tissue was on the point of escaping. An effective curettage and cauterization operation was regarded as impracticable. Accordingly the femoral head and neck were excised *en masse*, the neck being divided well beyond the presumed margins of the tumor. The stump of the upper end of the femur was cauterized with carbolic acid in the usual way. During the operation a rapid smear (Dugueon technique) of the tissue protruding through the hole in the articular surface of the femoral head showed the characteristic cells of a benign giant cell tumor.

*Description of specimen* About one-half of the interior of the femoral head was occupied by a multilobular area containing reddish brown tissue with "red currant" areas. There was a perforation of the articular surface in the region of the ligamentum teres attachment (Fig 6). Histological examination of contents disclosed a typical benign giant cell tumor, with giant cells in great profusion (Fig 6).

As it was believed that a clean sweep had been made of the tumor, it seemed reasonable to attempt to stabilize the hip joint at an early date. Some 2 months after the excision of the tumor, a second operation was performed (February 15, 1933) and included a reconstruction of the head of the femur by a homogeneous graft. The astragalus removed from a patient of a similar blood group with a long standing ununited fracture of the leg bones, was attached to the upper end of the femoral shaft (Fig 7). There was no naked eye evidence of recurrence of the tumor. Four months later the patient was fitted with a walking caliper. The hip joint was surprisingly stable and allowed a short range of movement. Six months from the time of the operation a roentgenographic examination showed a cystic change in the upper part of the shaft, suggesting recurrence of the tumor (Fig 8). There was no clinical evidence to support this conclusion. The patient was unwilling

Fig 1 Case 1 Cyst of pubis (ostitis fibrosa) in a girl aged 15. A cystic expansion of body and ramus of pubis on left side with considerable destruction of bony shell

the tumor as a *malicious*, although not a malignant, neoplasm. I have probably been influenced by the fact that more than half of the cases in my own series have been patients in the fourth or even fifth decade of life. Indeed, the surprising incidence of this tumor in the middle aged occasionally leads to difficulties in the differential diagnosis of solitary secondary malignant tumors of the long bones, where the primary growth is latent.

The inherent aggressiveness of the typical giant cell tumor is convincingly demonstrated in its tendency to recur locally after operations which, at the time, may have appeared sufficiently radical. The following case from my own collection is instructive in this respect.

Case 3 Female, aged 23 Giant cell tumor of head of femur, right  
The patient had had pain and a lump for 6 months. Examination disclosed the clinical picture of a subacute arthritis of the right hip joint. A roentgenogram revealed a faintly trabeculated cyst, occupying the lower half of the femoral head and extending into the lower border of the neck, bony shell almost disappeared (Fig 5). The first operation was done December 18, 1931, at which time the hip joint was explored and the head and neck of the femur resected. When the hip joint was opened and the femoral head inspected, a localized bulge of encapsulated tumor material was noted at the junction of the lower border of the head and neck. The femoral head was flattened and triangular in shape and showed a perforation of the articular cartilage in the region of the attachment of the ligamentum teres. Through this



Fig 3 Case 2 Cyst of femur (osteitis fibrosa) in a female aged 23. A large cyst arising eccentrically in the metaphysis showing marked attenuation of the bony shell on the superficial aspect

to give consent for further operation and, therefore, a course of deep X ray therapy was advised. Valuable time was lost before arrangements could be made for this treatment. In the meantime the cystic area had steadily increased in size (Fig 9). After the course of deep therapy the hip remained very painful, there was an increasing swelling of the soft parts and the joint became completely fixed. A further roentgenogram showed no shrinkage in the tumor area. The question of amputation was discussed but the patient consented only to a further local attempt to excise the tumor (Fig 10).

A third operation consisting of re exploration and excision of upper end of femur was done.

July 24, 1933 the dense fibrosis and adherence of the soft tissues to the bony shell and capsule of the tumor made the operation extremely difficult. As it was not felt certain that every particle of the bone shell and capsule had been eradicated, the operation wound was re opened 11 days later and radium tubes enclosed in a sorbo rubber pack were inserted. Progress following the operation was most satisfactory and sound healing of the wound rapidly occurred. Two months later the patient began to bear weight on the limb in a caliper splint.

**Result up to date.** One year after the last operation, there is no clinical or radiographical evidence of recurrence in the upper end of the femur. There is

gross shortening of the limb but the patient is able to walk quite comfortably in the caliper splint (Fig 11).

1. A giant cell tumor, actively invasive and destructive, occurring in an unusual situation and treated by a radical excision of the tumor bearing area (head and neck of the femur). A re exploration of the hip joint 2 months later for the purpose of insertion of a homogenous graft, afforded an opportunity of demonstrating the absence of naked eye evidence of local recurrence.

2. Unmistakable roentgenological signs of recurrence in the upper end of the femur were discovered 6 months from the time of the reconstructive operation, and ultimately the homogenous graft (astragalus) was completely invaded by tumor.

3. The recurrent tumor, which rapidly attained to a considerable size, continued to grow in spite of irradiation (deep X ray therapy).

4. The recurrent tumor was treated by excision and radium implantation.

5. The patient is still under observation and has remained free from signs of recurrence for a year from the date of the last operation.

I have recorded elsewhere a similar example of the recurrence of a giant cell tumor in a bone graft used to replace the metacarpal bone of a thumb after a previous excision of the original tumor (4).

3. *The malignant giant cell tumor.* The question of the potential or actual malignancy of the giant cell tumor has in the past excited considerable controversy. It is now generally admitted that, on very rare occasions, the tumor may assume all the local and metastatic attributes of a true malignant neoplasm. Whether this phase of activity represents a superimposition of malignancy on a benign tumor (Geschickter and Copeland, 1), or—more probably—a true dedifferentiation of the specific cells of an osteoclastoma (Stewart, 7), still remains to be settled by the pathologist. It is the sequence of events in the clinical story of the true malignant giant cell tumor which concerns us at the moment—a tumor with a long career, appearing in the first instance as a typical benign lesion between the ages of 30





Fig 4 Case 2 Histology showing parts of a giant cell tumor area

themselves no proof of malignant behavior, although they obviously call for drastic excision of the tumor bearing area, or amputation. Neglected tumors which fungate through the skin are fortunately an uncommon experience at the present day. I have had one example of this unusual clinical phenomenon in a tumor of the lower end of the tibia in a woman of 42 years, with a comparatively short history, and treated by a previous curettage. The histological picture was a typical benign osteoclastoma but no complete histological survey of the greater part of the tumor was made (Fig 12). The patient was known to be alive and well 1 year after amputation, but all efforts to trace her during the past 10 years have been unsuccessful.

So far it has not fallen to my lot to meet with an example of true malignancy in a giant cell tumor

#### TREATMENT OF THE GIANT CELL TUMOR

It will be generally agreed that, in the treatment of the giant cell tumor, our aims should be the complete eradication of the tumor with the minimum amount of mutilation. It is, therefore, pertinent to ask how far surgical treatment, as a primary resort, fulfills these requirements. The rôle of three types of operation must be considered (1) curettage, (2) local excision, and (3) amputation.

In a recent contribution, E. S. J. King of Melbourne, has described the histological and roentgenographic criteria on which a diagnosis of impending or actual malignancy may be made in atypical giant cell tumors. These, in his opinion, are (1) a predominating spindle cell stroma with mitoses and tumor giant cells, in addition to the typical benign giant cell areas in other parts of the tumor, and (2) loss of outline of the bony shell, irregular trabeculation, and the shadow of tumor material in the soft parts. King also challenges the well known dictum of Bloodgood that perforation of the bony shell is not necessarily a sign of malignancy. My own experience would tend to confirm the soundness of Bloodgood's teaching, for I have cured by curettage and cauterization tumors in which the bony shell had almost disappeared. The fibrous capsule was, however, still intact. But even the ultimate perforation of the fibrous capsule and invasion of the surrounding soft parts, are in



Fig 5



Fig 7



Fig 8

Fig 5 Case 3 Giant cell tumor head of femur (R) in a female aged 23. Lower half of the femoral head has been replaced by a faintly trabeculated cyst extending into lower part of neck.

Fig 7 Case 3 Femoral head and neck replaced by transplanted astragalus.

Fig 8 Case 3 Six months after astragalus transplantation. Decrease in size of the transplant and a cystic area in the upper part of the femur suggesting recurrence of the tumor.

#### SURGICAL MEASURES

**1 Curettage** The conservative operation of curettage and cauterization, which we owe to Bloodgood, has, in recent years fallen somewhat into disrepute. There can be no doubt that in the past, this operation has been practiced indiscriminately by surgeons with little experience in its specialized technique, and ignorant of its limitations. In a large group of giant cell tumors from the American Bone Sarcoma Registry analyzed by Simmons (5) some years ago, the cures following curettage were 62 per cent only. I believe, however that, in carefully selected cases, curettage should continue to be an operation of choice. For the indolent tumors it is of course an ideal procedure, but as already suggested, these are likely to be in a minority. The crucial test of the operation is its effectiveness in the early stages of rapidly growing tumors of moderate size, even after actual perforation of the bone shell has taken place (Fig 13). The technique of curettage is discussed too rarely, and, in consequence there is a belief that the operation is a minor procedure. The removal of every particle of tumor tissue from the interior of a large bone cyst, the control of the resulting hemorrhage and the final systematic chemical cauterization of the whole tumor cavity, is a precise technical performance, demanding both judgment and experience. The operation has too often consisted of a hasty "scrape,"



Fig 6 Case 3 Resected specimen. Histological features—great profusion of large giant cells.

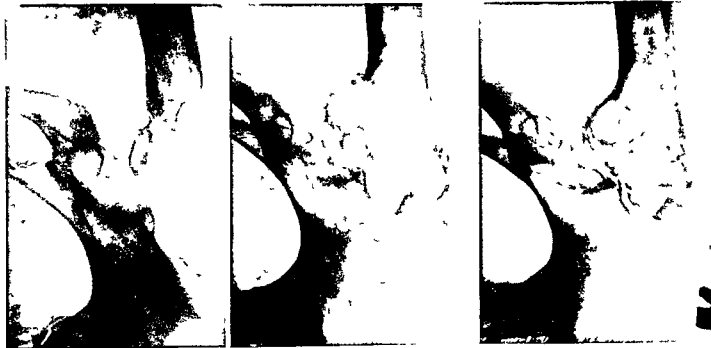


Fig 9 Case 3 Thirteen months after the astragalus transplantation  
Fig 10 Case 3 Seventeen months after astragalus transplantation  
Fig 11 Case 3 One year after treatment of recurrent tumor by excision, combined with radium implantation

by Simmons, the cures following the combination of curettage and irradiation were 72 per cent. My own experience of this technique, though comparatively small, is encouraging. I have had one striking example of the value of radium implantation, following incomplete curettage and chemical cauterization, in a large hemorrhagic giant cell tumor of the ilium which had burst through its bony shell. This was a tumor which, on the earlier histological findings, was at first regarded as a true sarcoma (4). This patient is alive and well 10 years from the time of operation.

In tumors in certain less accessible situations, curettage, followed by repeated courses of deep X-ray therapy, is an admirable substitute for the more mutilating alternative of resection. I have one such case under observation at the present time—a giant cell tumor of the head and neck of the femur—which appears to be undergoing progressive healing (Figs 14 and 15).

2 *Excision* As an operation of the first instance, excision is chiefly applicable in tumors of the upper limb, where excision of the ends of any of the major long bones, with the

In certain tumors of the lower end of the femur and upper end of the tibia (the classical sites), where there would be no difficulty in eliminating all traces of tumor tissue, the thickness of the barrier which separates the tumor from the cavity of the knee joint is the deciding factor. For during an efficient curettage there is a risk that a fragile shell may be cracked or perforated on its articular aspect. The dangers of repeated curettage are now well appreciated. If local recurrence follows a primary curettage, the second operation should be either resection or amputation, according to the anatomical indications.

The effective scope of curettage has undoubtedly been extended by the use of post-operative irradiation. In the tumors analyzed



Fig 12 Giant cell tumor lower end of tibia in a female aged 42 Showing fungation of the tumor through the skin

exception of the lower end of the radius (Figs 16a and b) If it is considered advisable that the resulting loss of bone should be made good by the insertion of an autogenous graft, it is wise to postpone the reconstructive operation until it seems certain that local recurrence is unlikely (see Case 3)

In the *lower limb* there are few opportunities of practicing resection, except in tumors in unusual sites such as the fibula or head of the femur for which curettage is considered to be impracticable

Compared with curettage the operation of excision gives a much higher percentage of cures—in the series already referred to (Simmons)—the ideal figure of 100 per cent

3 *Amputation* Little need be said on the general subject of amputation in the treatment of giant cell tumors In the *lower limb* the operation is inevitable in neglected tumors in the region of the knee which have progressed to the stage of advanced destruction with impending invasion of the knee joint, and in certain tumors which have recurred after curettage or have defied irradiation In tumors of the lower end of the femur or upper end of the tibia which can be cured only by curettage and cauterization at the expense of the integrity of the knee joint, the operation may be desirable at an early stage In patients of middle age, the economic advantages of amputation are considerable and the loss of a limb is a small price to pay for the elimination of a tumor which is obviously a menace to the patient's life

#### PRIMARY IRRADIATION

It remains to consider whether there is any justification for the use of primary irradiation as a substitute for operation in tumors which are still amenable to conservative operative attack In the uncommon giant cell tumors of the *flat bones*, e.g. the ilium, where curettage may be of doubtful efficacy, and complete excision impracticable, irradiation is the only form of therapy available But the deliberate choice of irradiation as a primary measure in tumors of the long bones is often, in my judgment a somewhat hazardous experiment There is not only the obvious objection that in the absence of histological evidence derived from a biopsy, the diagnosis may remain in doubt Still more important is the difficulty which arises in connection with the interpretation of the clinical, and more especially the radiographic, signs of healing in a tumor undergoing irradiation The appearance in the roentgenograms of zones of bone sclerosis at the periphery of the tumor, though suggestive of bone repair, is not convincing proof of the death and obliteration of the tumor cells *en masse* There is also the potential injurious effect of prolonged irradiation on articular cartilage to be reckoned with If the penetration is sufficiently powerful to kill an osteoclastoma of the lower end of the femur or upper end of the tibia, the knee joint is bound to suffer This objection applies equally to the use of irradiation after the operation of curettage For this reason, as a general rule, the use of postoperative deep X ray therapy should be

## PLATE THE GIANT CELL TUMOR OF BONE



Fig 13 An active rapidly growing giant cell tumor of the lower end of the femur, in a man of 30, with early perforation of the bony shell, and treated by curettage and cauterization. Shows condition 5½ years from the time of the operation

X-ray examination January 3, 1933, made after the original injury (Fig 17) showed localized eccentric cystic expansion of the external condyle with clear cut boundary and coarse trabeculation

Figure 18, a roentgenogram taken May 6, 1934, shows the cystic area much increased in size,

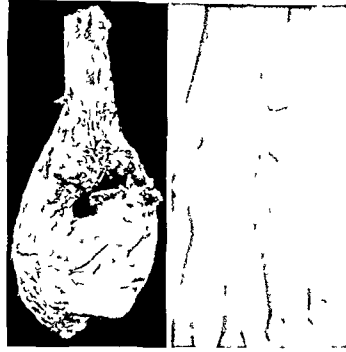


Fig 16 a, Giant cell tumor lower end of ulna, in a female aged 25. Treated by resection b, Specimen after excision

confined to tumors in situations such as the hip, where ankylosis may be far less disabling than the functional results of a resection of the upper end of the femur

I believe that valuable time may be lost in waiting for a tumor to heal under irradiation. It is not sufficient for the radiologist to claim that the tumor is held in check over a long period. If irradiation is to compete on even terms with the conservative surgical procedures, there must be convincing evidence in a short period of time of shrinkage of the cyst and obliteration of the cavity by new bone, without the clinical signs of deterioration of the joint in the neighborhood of the tumor. These points are illustrated in the following case of my own series

Case 4 Male, aged 56 years Giant cell tumor of lower end of femur, right

The patient suffered a contusion of the right knee, followed by a localized cystic expansion of the external condyle of the femur. Operation was not advised and a trial of irradiation was suggested. During the early stages, the tumor was believed to be under control, but during the last 6 months the knee became steadily more swollen, more painful, and fixed. On examination June 4, 1934, there was found a well marked enlargement of the external condyle of the femur with local tenderness, distended veins, the knee practically fixed in 15 degrees' flexion, marked wasting of the thigh



Fig 14, left, Giant cell tumor head of femur in a female aged 27. Pre operative X ray  
Fig 15 Giant cell tumor head of femur in a female aged 27 eleven months after curettage and cauterization, followed by deep X ray therapy. Appearance suggests oblitera-  
tion of the tumor



Fig 17 Case 4. Giant cell tumor lower end of femur in a male aged 56. Trabeculated cystic expansion of the external condyle with a fairly thick shell.

attenuation and partial disappearance of the bony shell, a line of fracture through the upper part of the cyst.

On June 10, 1934, a mid thigh amputation was performed.

*Description of specimen.* (1) A cystic expansion of the external condyle with an absence of bony shell on the superficial aspect. Contents of cyst, tissue of varied consistency and color. Small amount of fluid present. (2) The knee joint showed erosion of the articular cartilage on the adjacent surfaces of the external condyle and tibial tuberosity, with a strong adhesion binding the two surfaces together. Joint almost completely fixed.

Histological examination of the contents of the cyst revealed a typical benign giant cell tumor with no suggestion of malignancy: spindle and round cells with marked number of giant cells particularly in relation to large areas of hemorrhage.

Here is a giant cell tumor occurring in a man of 56 years (an unusually late age) which increased in size in spite of irradiation. When first discovered, the tumor could undoubtedly have been cured by curettage with the pres-

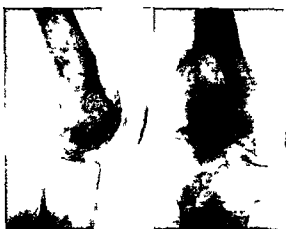


Fig 18 Case 4. The same cyst fourteen months later after irradiation showing considerable increase in size and attenuation of the bony shell.

ervation of a useful knee joint. Fifteen months later, when a surgical opinion was sought, the advanced destruction and the degenerative changes in the knee joint made amputation inevitable.

I believe it is not unreasonable to regard the case for primary irradiation as still *sub judice*. My own experience leaves me at the present time an advocate of early operative intervention. On this important aspect of the giant cell tumor problem, however, my mind is still 'open and to let.'

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be, as Mallory has called them, only "foreign body giant cells," though this hardly explains similar tumors, as epulis or tendon sheath growths. There is no question but that there is a definite class of giant cell growths. They are essentially benign, and usually can be diagnosed by means of the X ray. It is true that these tumors and certain cysts have much in common in appearance and in origin.

I agree with the speaker that operation is absolutely preferable to irradiation, I would go even further and say that irradiation usually acts to stimulate the tumor growth, the curative effect being only later and at the expense of unnecessary deformity from loss of bone.

Only when such tumors are found in the spine (recognizable in part by the characteristic invasion of the transverse and other processes) is the X-ray to be chosen as a means of treatment. Elsewhere thorough curettage and vaseline packing to allow healing from the bottom gives permanent cure in most cases.

We have seen several cases in which patients have remained cured, at least for years, after a second operation.

We have seen one case recur after 2 years' apparent healing, recurred upon, and become apparently well after a year, recurrences are usually rather prompt.

If a third operation is necessary, it should be resorted to.

We have data on but one amputation, amputation should have been done in one other case with recurrence and final death from thoracic metastasis. I am much interested in Mr. Platt's 40 year limit. One recalls in this commonwealth very few cases of giant cell tumors after 40 and based on the age of the patient there seems to be no exact or even nearly exact differentiation between giant cell tumors and their near cousins, the "solitary" cysts.

## Discussion

## PLATT: THE GIANT CELL TUMOR OF BONE

FREDERIC J. COTTON, M.D., F.A.C.S., Boston  
 Somehow, the age discrimination seems less clear cut in our experience than in Mr. Platt's. We have seen a good many typical giant cell tumors in children, a good many cysts in adults, which by no means are always to be connected with lime abnormalities or parathyroid activity. One recognizes, of course, the odd solitary cysts encountered in adolescence. These are obviously dysplastic, but their origin is not clear, a parathyroid background has not been established in my cases, though to be sure many of them antedate modern exact chemistry.

The giant cell tumor is, however, a distinct entity, and, as Mr. Platt has said, of varying type as to growth rate (therefore as to bone expansion) and as to tendency to recur.

The arch type is the tumor para epiphyseal, later, in a bone end, it may show some bone expansion, characterized by irregular outline, particularly by apparent trabeculation, and by a tendency to involve, progressively, all parts of a given bone. Invasion of the soft parts or of the adjacent joints occurs late if at all.

There is definite evidence to support the statement that giant cell tumors do degenerate to form cysts, and transitional forms are not rarely met with. Some confusion may arise here because real cysts of any origin may show in the lining membrane giant cells in some number. Giant cell tumors may be associated with cysts in the same individual—both of obvious parathyroid background. On the other hand giant cell tumors which do not become cysts or retrograde into scar fibroma, may, and not seldom do, recur, even after excision by a technique ordinarily efficient, they may very rarely give rise to chest metastases of similar apparently non malignant histology.

It must be remembered that these giant cells are the bone eaters and that their presence in granulation tissue—for that is the mass of the tumor—may prove only the destruction of bone. They may well

## ENDOCRINE MECHANISMS IN CERTAIN FUNCTIONAL GYNECOLOGICAL DISORDERS<sup>1</sup>

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NO apology need be made for discussing functional disorders before an audience of surgeons who in the popular mind at least are the artisans of the medical profession. Certainly in gynecology more than in any other branch of surgery an ever-increasing proportion of our patients invoke the science as well as the art of our calling. If I may very immodestly, quote from a previous paper of my own "if the proper study of mankind is man, the proper study of gynecology is woman, in all her varied biological aspects, rather than merely as a creature possessing pelvic organs of certain shape, size and position." To achieve such breadth of viewpoint a knowledge of the more static subjects of the anatomy histology and pathology of the generative organs must be supplemented by a familiarity with the physiological and endocrinological forces which vitalize these organs.

The approach to clinical problems of the gynecologist interested in endocrinology is apt to be very different from that of the man so unfortunate as never to have interested himself in this new and fertile field. To the first such a symptom as uterine bleeding may mean a careful search for anatomical causes, and, if none are found an assumption of functional or perhaps even "idiopathic" etiology. His more physiologically minded confrere, however, tries to go a step further and, knowing something of the normal physiological forces, tries to determine what the nature of the functional upset may be. Again where one type of gynecologist will open the abdomen with an eye only for structural deviations, the other includes in his survey a consideration of such physiological factors as may often be deduced from careful inspection of the ovaries, coupling with this the information gained from a careful history and a really comprehensive physical examination, which must often include all the interlocking ductless gland structures. Innumerable examples

might be offered in support of this general thesis, and some I shall have occasion to stress later in this paper. One need no longer fear that an interest in endocrinology will expose one to the criticism of being a "ductless gland faddist" and it is no mere literary overstatement to assert that a working knowledge of endocrinology is indispensable to the gynecologist who would practice his specialty intelligently.

To argue that our knowledge of gynecological endocrinology is very incomplete and that the subject is a bewildering one to the neophyte, or, for that matter, even to investigators who have worked intensively in this field, is merely begging the question. A sufficient number of facts have been crystallized out to change and to freshen our viewpoints on many old problems in both reproductive physiology and clinical gynecology, and this modicum of knowledge it is not difficult to acquire. The disappointments of organotherapy should be no deterrent, as seems to be the case with many. Nothing can be much more certain than that the brilliant advances of reproductive physiology will bring their therapeutic reward in the not very distant future, but we need not wait for this, to develop an interest in endocrinology. Even in its present undeveloped state it can aid much in the interpretation of clinical problems and can make our daily work as clinicians much richer in interest and zest.

### THE NORMAL CYCLE

It goes without saying that a discussion of the endocrine mechanisms in gynecological disease presupposes some knowledge of the endocrine mechanism of the normal genital cycle. A still broader knowledge will come from a study of this phenomenon from a comparative standpoint. This is not the place to review the normal physiology of menstruation, I have done this in several previous publications. As a basis for our discussion of

<sup>1</sup>Presented before the Clinical Congress of the American College of Surgeons, Boston, October 15-19, 1934.





Why there should be these great differences in the grade of proliferative picture encountered in cases of functional hæmorrhage I do not know. The first thought would be that the intensity and duration of the estrin stimulation is the determining factor, but this does not seem to be borne out by the clinical study of these cases. Whether the degree of receptivity of the endometrium is responsible or whether some as yet unknown interaction of the ovarian and anterior hypophyseal sex hormones must be invoked remains to be seen. The possible rôle of the rate of excretion from the body of the causative hormone or hormones must also be considered though since the bleeding and the histological picture in the endometrium are "local phenomena" in that tissue I do not believe that the factor of excretion rate can explain these local variations.

The pathologist who expects to see a typical swiss cheese endometrial pattern in every case of functional hæmorrhage is apt to be disturbed if he finds only a proliferative picture scarcely or not at all distinguishable from that seen in the early interval phase. Instead of straining his eyes to look for an occasional dilated gland to justify him in the diagnosis of hyperplasia he need only recall that just as the interval pattern is that of the basalis raised to a somewhat higher power, so is the swiss cheese hyperplasia pattern only a still higher power of the interval picture. The term hyperplasia is a misnomer in not a few cases both from a gross and microscopic standpoint. A better plan would perhaps be to designate such endometria merely as proliferative estrous or hyperestrous, the inference being that we are dealing with a purely estrin produced picture.

Some authors have reported the finding of premenstrual secretory endometrium in cases of functional bleeding. Since no hormone except that of the corpus luteum can produce these secretory changes, this finding at once removes such cases from the category under present discussion though they may possibly still be of functional nature. To put it another way there is little doubt that other factors than hyperestrinism may at times produce excessive bleeding even with apparently

normal organs, though my experience leads me to believe that this group is a small one. That the uterine musculature may at times be at fault with the production of a genuinely myopathic bleeding, seems probable, though it is difficult to prove. The same may be said as to a possible rôle of the vascular and vasomotor systems, or, for that matter, of the nervous system in general. We are in almost complete ignorance of these cogs in the menstrual machinery our knowledge of the latter being almost entirely limited to its endocrinology and histology.

In the occasional case in which a secretory endometrium is found in association with supposed functional hæmorrhage my own reaction has been to suspect the correctness of the diagnosis and to bear in mind the possibility of some not easily discoverable structural lesion such as a submucous myoma, a uterine polyp, or a low grade chronic pelvic inflammatory disease. This is not to deny the possibility of functional hæmorrhage due to other causes than the persistent unruptured follicle especially as we know too little of the possible rôle of other endocrine glands, such as the thyroid in this connection. Occasionally though not often, functional bleeding is clearly due to hypothyroidism, and readily cured by thyroid medication.

*Pathological physiology.* To revert again to the pathological physiology of the common type of functional bleeding, I have already stressed the fact that, so long as the endometrium is receiving a steady supply of estrin, bleeding does not occur. How, then, can we explain the bleeding phases sometimes short, more often prolonged, often periodic, not infrequently very irregular, not rarely continuous? On the basis of what is now accepted as to the hormone mechanism of menstrual bleeding in the human female or of estrous bleeding in some of the lower animals, the obvious explanation would be that the estrin blood level undergoes drops at varying intervals and that it is this estrin withdrawal from the endometrium which is responsible for the bleeding.

What explanation, however, can we make as to these intermittent drops in the estrin level? For this we must turn to the reciprocal

as the swiss-cheese pattern is concerned, is quite similar to that seen in the non-bleeding phase, there being no such histological cycle as occurs in normally menstruating women. So far I have discussed chiefly the ovarian hormones as direct causes of this disorder

In conformity with the general subversiveness of the ovary to the anterior lobe, there can be no doubt that the underlying cause is to be sought in the latter. The polian A principle is obviously the dominating one, concerned as it is with follicle ripening and the production of estrin. The absence of corpora lutea in the ovary would indicate a lack of adequacy of polian B, the intensifying principle of the anterior lobe, if we accept the concept of the duality of the two principles. The fact that some excellent physiologists believe that it is the intensifying principle which is also responsible for ovulation would explain the failure of ovulation in cases of this type. On the other hand, the recent studies of Kurzrok suggest that polian A is the factor concerned with ovulation, if the finding of polian A just before the ovulation time may be accepted as evidence to this effect.

Already there is a considerable body of experimental evidence to confirm the natural assumption of the underlying role of pituitary dysfunction as the cause of functional hemorrhage, but when we try to seek even further, for an explanation of the pituitary disturbance, we meet the same stone wall which faces us when we seek for the underlying cause of menstrual rhythm and periodicity. The secret is still sealed within the pituitary, to which all evidence points as the ruler of this rather turbulent endocrine republic.

**SOME ASPECTS OF STERILITY AND FERTILITY**  
Women who are suffering with functional bleeding associated with hypoplasia of the endometrium are characteristically sterile, for they do not ovulate. Furthermore, since there are no functioning corpora lutea in the ovaries, there is a lack of the progesterin so indispensable for the premenstrual changes without which implantation can not occur. And yet in many of the milder cases the bleeding is periodical, the normal menstruation, and the amount of the flow may be only slightly above

relations existing between the ovarian and anterior hypophyseal sex hormones. While it is true that the anterior pituitary lobe is the "motor of the ovary," and that failure of anterior pituitary function means a failure of the ovarian function, it has been established that the ovary in turn exerts a reciprocal effect upon the anterior lobe. The work of Moore, Hisaw and his collaborators, as well as other investigators, has shown that prolonged and excessive estrin administration is followed by inhibition of the anterior lobe function, and that, with the latter in abeyance, there follows an inhibition of ovarian activity.

In our cases of functional bleeding, a similar mechanism seems to operate, so that, when the estrin level reaches a certain point, there is produced an anterior pituitary inhibition, and in turn an inhibition of follicular activity in the ovary, with the drop in estrin which is responsible for the bleeding phase. I have compared the mechanism to that employed in our automatic heating systems in which the production of heat is automatically shut off when the temperature of the house reaches a certain level. The interlocking relationship between the two glands is thus seen to be not only qualitative, but also quantitative, and, in fact, a fact often overlooked.

As to the local or anatomical findings in the bleeding phase, with which we are not directly concerned in this paper, suffice it to say that there is no such extensive degeneration as is seen during menstruation, although small, localized, infarct-like areas of necrobiosis are commonly seen. Schroeder believes that these small areas are the source of all the bleeding, an explanation which, to me, has never seemed to carry conviction. It is difficult to believe that such tiny areas could give rise to the very massive hemorrhages sometimes observed, especially in view of the moderate bleeding characterizing normal menstruation, where practically the entire surface is lost. Some other factor, such as increased permeability of the blood vessel walls and increased diapedesis, must be involved to explain the bleeding from a surface which grossly, at least, often appears quite intact. The histological picture during the bleeding phase, in so far

normal I emphasize this because it illustrates the fact that periodical bleeding not distinguishable clinically from normal bleeding may occasionally occur without ovulation. In the overwhelming majority of women, of course, the mechanism is of the well known ovulatory variety, but the exceptions to this rule are, I believe, more frequent than has been believed. My observations lead me to think that even if menstruation is normal, the non ovulatory type of periodical bleeding is not rare in women near the two extremes of menstrual life, when pathological functional bleeding is so often seen. A normal puberty presupposes a perfect conjunction of several endocrine phenomena, and this does not always occur. For example, the follicle ripening mechanism may be operative before the ovulating and luteinizing effects are unimpaired and an anovulatory type of periodical bleeding clinically quite similar to normal menstruation may occur. This is an adequate explanation of the well known fact that nubility and fertility are by no means invariably synchronous.

As the woman approaches the time of actual menopause it is quite possible for the cycle again to revert to the anovulatory type the common estrin progesterin sequence being superseded by a purely estrin mechanism in so far as the ovaries are concerned. At any age during the reproductive epoch as a matter of fact, such a mechanism may develop and this possibility must be borne in mind in seeking for the cause of otherwise unexplainable sterility.

There has been much discussion as to whether the anovulatory type of cycle, admittedly the exceptional type in women, is to be considered pathological. Differences in opinion on this point are explainable entirely by differences in the definition of menstruation. If the traditional definition of menstruation as a periodical discharge of blood from the uterine mucous membrane is accepted, certainly anovulatory bleeding of the periodical type under discussion comes within this definition. If on the other hand, one adds to the definition the requirement that ovulation and corpus luteum formation must occur, it is obvious that anovulatory bleeding is always

pathological, even though it clinically simulates normal menstruation perfectly.

Such a restriction of the definition reminds me of the rapid mental shift exhibited by the Turkish physician in a case quoted by Garrison in his *History of Medicine*. The patient was a Turkish upholsterer who, during the delirium of typhus fever, drank from a pail of pickled cabbage and recovered, whereupon the Turkish doctor declared cabbage juice a specific for the disease. The next patient dying under this regimen, however, they modified the dogma by saying that cabbage juice is good for typhus provided the patient be an upholsterer.

My own viewpoint is that the time honored clinical concept of menstruation as a periodical uterine bleeding, enunciated long before we knew anything of possible differences in its hormone mechanism, is the logical one to accept. Corroborative evidence of the two types of menstruation has been abundantly furnished by students of reproductive physiology in monkeys, in which the cycle is so similar to that of women. The two types are seen, not only in different monkeys, but also in one and the same animal at different seasons of the year even though the menstrual flow itself shows no alteration in rhythm or amount.

#### OVULATION TEST

The occasional importance of the above facts in the study of our sterility cases is obvious. The question naturally arises as to whether or not we can determine whether the individual patient is ovulating. This can, I think, be unhesitatingly answered in the affirmative. The endometrium is the registering board of the two ovarian hormones, and we know the effects which each produces upon it. The ovulation test, as we designate it, consists simply in obtaining for microscopic examination a bit of uterine mucosa shortly before the expected onset of a period. If the woman has ovulated, a corpus luteum has been formed in her ovary progesterin has been secreted and definite secretory changes have been produced in the endometrium, as can be determined by simple microscopic examination, with occasional differential staining for confirmation.

If on the other hand, a proliferative, non-secretory picture is found, we may conclude that there is no corpus luteum and that ovulation has not taken place. I could cite a number of instances in which this test has proved of much value. For example, in a recent patient, aged 39, in whom both tubes were blocked at the isthmus, and in whom I had planned performing resection of the closed portions and tubo-ovometrial anastomosis, the finding of a non-secretory endometrium just before menstruation prevented an operation which would undoubtedly have been useless.

Once again I emphasize that the anovulatory cycle is the unusual one in women, and that in the vast majority of women a secretory type of endometrium is to be expected just before menstruation. But in the comparatively small group of cases of otherwise unexplainable sterility, where tubal patency tests, endocrine studies, metabolism determination, semen examination, and other studies have failed to reveal a cause, I am inclined to think that, as opportunities for observation increase, a not inconsiderable proportion may be explained by failure of ovulation. This is especially to be sought for if the menstrual periods are somewhat free and perhaps slightly irregular.

I emphasize once more the importance of the microscopic study of the endometrium in the study of functional menstrual disorders, for this tissue is a mirror of ovarian activity, and we can often learn more from it than we can from blood and urine hormone studies. Important as the latter are in many cases, quantitative hormone study of blood and urine, moreover, is impracticable in everyday practice, while valuable information is often obtained from the far simpler histological studies of the endometrium.

To obtain tissue from the uterus, an anesthetic is not by any means always necessary, although this would be fully justified by the value of the information gained. In the majority of cases, however, specimens for study can be obtained without anesthetics, either by using a curette sufficiently small to pass through an undilated cervical canal, or by some form of suction. During the past year

or so, I have been using suction by means of the electric motor pump, the cannula for introduction being a modification of the Rubin insufflation cannula. More recently still, we have modified this by building a very small serrated curette on the open end of the cannula. By means of this suction curette and the electric pump we can almost always obtain sufficient tissue without anesthesia for microscopic examination, and in some cases, in which the endometrium is sufficiently loose and fluffy, can perform a fairly complete curetting. The powerful suction engendered by this method is apt to cause some pain, but this is usually easily bearable and the procedure requires only a few moments. After all, however, any method which will yield tissue sufficient for diagnosis, without pain to the unanesthetized patient, should be satisfactory. If light anesthesia is required, as is sometimes the case, there is no reason why the customary dilatation and curettage should not be carried out.

The rich possibilities of this suction or suction curette technique for the investigation of other intra-uterine conditions may be mentioned in passing. I need only suggest that it will furnish an excellent means of studying the day to day variations in such conditions as amenorrhea, in some of which, at least, a histological cycle does occur, as I have found in a few cases. How does such a cycle differ from the normal, and what takes the place of the bleeding phase? Again, if a sufficient number of such procedures are carried out, it seems reasonably sure that embryologists will be made happy by the accidental finding of fertilized eggs in earlier phases, whether implanted or unimplanted, than the 9 to 11 day old Müller ovum.

Finally, as regards the anovulatory type of cycle, it should be added that this is only one of the endocrine mechanisms which may be concerned in sterility, though with the others there is often some manifest suggestion of endometriopathy. For example, in the far more common form of sterility associated with adnosenorrhea and a rather characteristic type of postgenital dysplasia there are present also

appearance of estrin occurs during the menopause confirm this impression, although it has been shown that the climacteric is an epoch of changing blood and urine hormones, with excess of estrin in some phases decrease in others, while in still others the chief feature is the excess of prolactin. I have been impressed with the infrequency of troublesome vasomotor symptoms in cases of functional menopausal bleeding commonly accepted to be produced by hyperestrinism. It would be foolish to generalize on the basis of such observations but the widely prevalent use of estrogenic substances in the treatment of the menopausal symptoms is certainly given a measure of support by this circumstantial evidence.

#### OTHER INTERESTING ENDOCRINOPATHIES

Another, though rather rare, type of endocrine disorder in which I have been much interested is that observed in association with certain ovarian tumors which among other endocrine effects, produce at times a remarkable change in secondary sex character. One not very rare group of tumors the granulosa cell carcinomata exhibit a strong hyperfeminizing influence, so that in children they bring about precocious puberty and menstruation, while in elderly women they may produce an apparent re-establishment of menstruation. The opposite group, the arrhenoblastomata secrete the male instead of the female hormone, and thus elicit phenomena indicative of masculinization and defeminization. These tumors however, constitute a story in themselves and one inextricably bound up with the still hazy story of sex differentiation in general so that this variety of endocrinopathy must be passed by with mere mention. For a discussion of the subject the reader may be referred to the recent paper by Novak and Long.

I would have liked to discuss such interesting clinical applications of biological knowledge as are illustrated in the treatment of the gonorrhoeal vaginitis of children by the estrogenic substances and the treatment of undescended testis by the administration of the anterior pituitary like hormones of pregnancy urine. It might have been of interest,

too, to discuss the diagnostic and prognostic application of the pregnancy tests in the management of hydatidiform mole and chorioepithelioma.

Another question inviting discussion is the possible application of the "law of follicular constancy," as enunciated by Lipschuetz, in the explanation of the cystic degeneration of conserved portions of ovarian tissue, and perhaps the responsibility of pituitary dysfunctions of one sort or another for many cases of cystic ovarian degeneration. Certainly the histological pictures found in such cases are quite similar to those found in the ovaries of laboratory animals after injection of pituitary extracts of one form or another.

Finally, it might have been of interest to include a discussion, though it must have been a speculative one, about the reverse effects of pelvic anatomical lesions upon not only the ovarian but also the pituitary function. Certainly it is difficult to explain in any other way the disturbances of menstrual amount and rhythm which are so common with uterine myomata, ovarian tumors, chronic pelvic inflammatory disease, and other pelvic lesions. A comprehensive survey of the functional disturbances would also have to include many cases in which definite anatomical lesions are present in the pelvis. I need cite only one instance that of ectopic pregnancy, for without question the mechanism of the endometrial bleeding characterizing this condition is a hormonal one emanating primarily from the ectopic trophoblast. Many other examples might be discussed were there time for this.

#### EPILOGUE

While it is difficult to condense into a short summary the rather general discussion of endocrine relationships in which I have indulged, I would again emphasize the patent indispensability of a knowledge of such matters to the gynecologist who would practice his specialty intelligently. An interest in endocrinology will change one's whole clinical viewpoint and will freshen one's interest in many clinical problems which have threatened to become hackneyed and stale.

While our knowledge of the subject is still incomplete and in many fields only nebulous,

Many other fields of investigation, rich in promise to both scientist and clinician, lie before us. The laboratory investigator must bear the brunt of the burden, but the clinician can be, if he will, a valuable co-worker rather than a mere parasite. This is possible only if he has prepared his mind by familiarizing himself as fully as possible with what has already been accomplished. His insight into his clinical problems will be clearer and deeper if he views them with one anatomical and one physiological eye, harmoniously co-ordinated so as to bring these problems into sharper focus than it is possible to do in another way.

## Discussion

Dr GEORGE WY S SMITH, Brookline Dr Novak's lucidity in dealing with these hormone mechanisms calls forth deep admiration on my part. His conservative but free thinking has been of real aid to us all in crystallizing our present knowledge of the sustaining factors of the endometrium. In confirmation of this, it has been observed that very large amounts of estrin given just before menstruation have resulted in a lessened or even a scanty flow. Furthermore, the more or less intact estrous endometrium of typical dysfunctional bleeding supports the idea of the sustaining ability of estrin. However, our knowledge of what happens at the time of conception, and the ability of progesterin to prevent or stop bleeding in women, or experimentally in monkeys, makes it necessary to consider the luteal hormone a sustaining factor also. I hesitate to complicate, by theoretical considerations, the clear description that Dr Novak has presented of the endocrine situation in endometrial bleeding, but feel that a few points might be brought out to demonstrate that the picture is not yet complete. Hemorrhage into the follicle ruptured by ovulation is well known. Careful studies show that at the time of ovulation there is actual extravasation into the endometrial stroma and occasionally blood is passed from the uterine cavity. Could this bleeding be due to a drop in the level of estrin? It does not seem so, since estrin is known to be on the increase at this time. If endometrial flow is the result solely of the removal of the two sustaining factors, estrin and progesterin, why is it that other animals with regular ovulatory cycles do not show this phenomenon? Dr Novak has found evidence of an ovulatory cycle in women with amenorrhea by histological studies of the endometrium, and we have demonstrated the same thing by the finding of cyclic rises and drops in the amount of prolan A excreted by a patient. Until recently we thought we had been estimating urinary estrin with a fair degree of accuracy, but now we find that the simplest expedient of boiling urine with

In support of this idea of another factor or combination of factors in order to explain these discrepancies

At present we decidedly agree that microscopic study of the endometrium gives much more reliable information than quantitative hormone analyses do for extraction and biological assay of prolan and estrin in the blood and urine of non pregnant subjects. We do not feel that we can determine even approximately the amount of prolan A excreted by a patient. Until recently we thought we had been estimating urinary estrin with a fair degree of accuracy, but now we find that the simplest expedient of boiling urine with

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concentrated hydrochloric acid gives values up to 10 times higher. We are thus hopefully struggling for refinements in quantitative methods and anticipate discovering in this manner much more than it is possible for examination of the endometrium alone to reveal.

I am much intrigued by the finding of a cyclical increase in weight in relation to menstruation. Weight increases have been observed in cases of migraine before attacks, at which time urinary prolactin A has made its appearance. In view of the recently discovered hormonal changes in certain toxemias of pregnancy, I am of the opinion that the edema seen in these conditions often has a hormonal background.

Allow me to emphasize Dr. Novak's exhortation that even in its undeveloped and apparently complex state, present day knowledge of these mechanisms is not difficult to acquire and can aid much in the interpretation of clinical problems.

DR. JOE VINCENT MEIGS, Boston. We have been privileged to hear Dr. Novak present a most interesting, entertaining, and thorough paper on a very difficult subject. It is probable that many have understood all he has related but it is more probable that some have not. The latter is not due to Dr. Novak's lack of clearness but is due to a lack of understanding of the terms used and the complexity of the problems. Most of us who are working in this field and have a satisfactory knowledge of the terminology must stop and think over his reasons for believing as he does. If certain phenomena that we have all noted in our work could be explained by some of his theories then we should have a more intelligent conception of his subject. For example, he has spoken of endometrial biopsy and we have noted in our work in the Ovarian Dysfunction Clinic of the Massachusetts General Hospital that this slight operation upon amenorrheic patients is sometimes followed by a menstrual period. If this is true we may assume that ovulation has taken place (an observation first brought to our attention by Burkh) and it should follow then that some of the pregnancies noted after the Rubin test and after lipiodol injection of the uterus and tubes can be explained. For if ovulation takes place in certain instances after instrumentation of the uterine cavity, conception might perhaps occur. It has long been noted that after a dilatation and curettage of dysmenorrheic and amenorrheic patients the patients' periods become more regular and less painful and that fertility is raised. Perhaps instrumentation of the uterine

cavity by restoring ovulation and normal menstruation, is responsible for some of our successes.

Again it has been noted by all of us that after a thorough curettage of the patient with abnormal uterine bleeding a normal menstrual rhythm frequently follows. This may be due not so much to the curettage and removal of the hyperplastic endometrium as to some stimulation of the pituitary gland and through it of the ovary, causing a normal rhythm to follow. Many practitioners often ask why it is necessary to give radium and X-ray treatment or to operate upon patients with abnormal bleeding since curettage has cured so many. We who are surgeons and users of radium are often at a loss to explain some of the excellent results in patients treated in this simple manner. It is quite probable that the stimulation of the endometrium or uterus may restore normality to the pituitary and ovary and therefore put an end to the abnormal bleeding. The mechanism whereby ovulation occurs following instrumentation is not clear at present but it is interesting to note that the female rabbit ovulates only at the time of coitus and that pseudo-pregnancy with corpus luteum formation follows in the mouse after copulation with a sterile male.

Dr. Novak has stated that one type of abnormal bleeding is due to continuous estrin production and that there is frequently a persistent follicle and absence of corpus luteum formation. There can be no doubt of the truth of the statement for all of us have noted these findings during pelvic operations. If the persistent follicle (usually a small cyst) is removed, normal menstruation will be resumed. It has been suggested that rupture of such a cyst during bimanual examination might restore menstruation. Such a maneuver has been described and advocated in the literature and in my practice I have noticed its effect on two occasions. It would be hazardous to advocate such a procedure, but it is evident from this discussion that removal or rupture of a persistent cyst containing estrin causes the normal rhythm to be resumed and therefore Dr. Novak's explanation of such bleeding cases is certainly upheld.

There are many other practical applications and many other observations that come to our minds as we master the knowledge of what has already been worked out by men interested in endocrinology. Dr. Novak is certainly one of the foremost among such investigators and his paper this evening demonstrates his great knowledge of the subject. I would like to thank him for all I have learned from his talk tonight and from the study of many of his excellent publications.



## THE UNSOLVED FRACTURE

KEI LOGG SPLD, M D, F A C S, CHICAGO, ILLINOIS

but the character of the accident would differ, the nature of the injury could scarcely be discerned and the patient's bones would unite with little attention on the part of the surgeon."

In 1834, there were claimed to exist 19 specimens of healed fracture of the neck of the femur in the various museums of the whole of Europe, including the 3 of Alibiagnic at the DuFuytren museum and Tilanus' 3 at the Hospital of St Peter at Amsterdam. Hamilton was inclined to doubt the utility of some of these specimens and believed that many of them were the results of old rachitic or other deformities. Some of these doubts were later sustained by Bassett and aired in his monograph. It was further stated by Hamilton before 1880 that the number of specimens to be found in American museums was probably as great as all those in Europe and he advised that treatment "ought to be directed to the retention of the bone in place, by suitable mechanical means for a length of time sufficient to insure bony union, or for so long a time as the condition of the patient will warrant." He employed a long side splint with extension of 10 pounds applied by adhesive tape to prevent eversion of the limb but failed to employ any abduction.

Anatomical study of the neck of the femur has been directed along the lines of the architecture of the lamellar construction of the head and neck in relation to the trochanteric portion of the bone in weight bearing axis to obtain a more or less diagrammatic viewpoint of how the angulated neck earned the superimposed body and yet permitted freedom of motions in the hip joint. The internal arrangement of the bone is found to conform to the requirements of these two purposes and to fit in with the general supporting trabecular scheme of the pelvis as carried up to the spine. Another most important point has been an acceptance of the idea that the blood supply of the head and neck comes from 3 sources (1) through the ligamentum teres, the arteries

by clinical ties, the selection of a tal. on fractures should cover a practical subject which might suddenly be of interest to any one of us. The unsolved fracture is chosen for discussion because it is the major peripheral fracture of our skeleton, and because for more than a century its treatment and the results have been a matter of controversy and inquiry among surgeons, and although the results obtained today show improvement, they are not at all comparable to those of other fractures. The progress in the investigation of fracture of the neck of the femur has been along many lines which can merely be mentioned here without discussion of their details. The collection of our surgical literature, reports for the most part being based on observations and research in anatomy, physiology, pathology, roentgenology and treatment, including end results

articles appended to this paper is a list of recent

One hundred years ago the difficulties in treatment of this fracture, which was recognized as of major importance and had already involved years of study, were discussed by Sir Astley Cooper in his work on "Dislocations and Fractures of the Joints." He said in part "In the examinations which I have made of transverse fractures of the cervix femoris, entirely within the capsular ligament, I have only met with one in which a bony union had taken place or which did not admit of a motion of one bone upon the other. I believe the reason that fractures of the neck of the thigh bone do not unite is that the ligamentous sheath and perosteum of the neck of the bone are torn through, that the bones are consequently drawn asunder by the muscles, and that there is a want of nourishment of the head of the bone, but I can readily believe, if a fracture should happen without the retracted ligament being torn, that as the nutrition would continue, the bone might unite, fracture of the neck of the femur pre-ented before the Clinical Congress of the American College of Surgeons, Boston October 1-19, 1914



Fig 1 Head removed November 14 1931 13 months after fracture with non union The dark areas show bone of original density as of the time of accident now aseptically necrotic The lighter areas represent efforts at bone replacement and revascularization The cartilaginous rim seems quite intact without pleating On the neck surface is found bone absorption and wearing away of osseous structure The finer details and microscopic findings have been given in other articles

of which are shown by Chandler and Krescher to be present in nearly all individuals, (2) the periosteal vessels and (3) capsular branches of the anterior and posterior cervical arteries We have also come to believe that there is some extension of blood vessels through the epiphyseal plane into the head from the superior nutrient artery

Physiological investigation has been directed toward the changes in this part of the bone during adolescence and senility and their relation to bone repair after fracture Study of sections of the femur confirming old observations demonstrate that in senility the canal

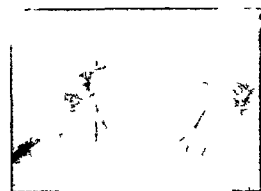


Fig 3 Left figure reduced fracture of neck in a large heavy woman, 73 years old in the conventional position and plaster dressing May 2 1932 The head appears viable Right figure same hip May 17 1933 The patient had 18 weeks in plaster then wore a walking caliper for 7



Fig 2 A post mortem specimen removed 14 months after fracture treated in the conventional manner Ir-rotation and apposition of fragments was evidently obtained with light rotation of the head but very little evidence in the gross specimen of any mal position The main portion of the head seems alive with some lighter areas around the rim as of bone replacement but no true bony union has occurred and no effort at new bone formation has started from the trochanteric fragment The angulation of the trabecular lines at the fracture plane and the loss of density in the trochanteric portion of the bone are apparent The specimen does not show definite bone replacement as starting from the vessel entering via the fovea which may have been occluded or of minor caliber yet the head is not dead *en masse* No weight bearing had ever been permitted so that factor of pressure is eliminated Note the intact cartilage Non union to a live head

openings in the bone enlarge in diameter especially in the neck where the cortical shell of bone is the thinnest but contrary to previous understanding according to Radasch the



months The head still seems viable and the union at the neck holding She was continued on the caliper 3 additional months and now has satisfactory functional use of the joint with no further bony changes Union to a live head

amount of organic material in the bone slightly increases in ages from 60 to 90 years. The average adult has 39 to 40 per cent of organic material in his femur, whereas in advanced age, a proportion as high as 42 per cent is maintained. The cause of fragility in old bones cannot then be ascribed to their loss of organic material with resulting change in the elasticity required for resistance to stress, but must lie in the change in porosity and thinning of the bony wall, which overbalances any gain of organic material. Although repair by callus after fracture will be attempted in this sense of bone, the effort must represent a distortion of ordinary healing, inasmuch as the regressive changes incidental to age still go on and two conflicting processes are at work.

No accepted evidence has been offered of the exact physiological nature of the changes affecting the epiphyseal area before the occurrence of separation of the epiphysis in adolescents to prove that it is directly based on local or constitutional disease. Many instances occur in fat youths, but no definite relationship between thyroid, hypophysis, or other endocrine disturbance accounts for all cases. Some have shown pre separation changes, betrayed by a luckily made X-ray examination, or symptoms of slight pain or lameness have existed prior to separation. Mild trauma or muscular action can be traced in the final cause of nearly every one

Fig. 4 Hip of a young man 8 years after traumatic epiphyseal separation at the neck of the femur, replaced accurately, immobilized 16 weeks, and supported with a walking capter 10 months. He had grown 8 inches in height following the separation, with  $1\frac{1}{4}$  inches shortening in the injured leg, very good final painless function, range of motion in joint restricted about 50 per cent. The head has broken down with flattening and abundant new bone has formed in the neck. Union to a head undergoing late aseptic necrosis with deformity and joint changes involving the acetabular surface.



A glimpse at the reported investigations of local pathology betrays the great interest in this phase of the fracture. Most important have been the findings in the hips of patients on whom operation was performed and the relatively scant post mortem material obtainable. The amount of tear in the capsule of the joint—rarely complete,—the character of the fracture plane, and especially its reduction and the rapid loss of bone substance in union—mobilized or reduced cases has been watched



Fig. 5 a, Impacted fracture of left neck before reduction in a heavy woman 55 years old. Manipulative reduction 5 days later, on February 17, 1933. She had walked on the fracture several days and had considerable pain. Head seems viable and somewhat rotated. b, Same, both hips May 18, 1933, after conventional 18 weeks in plaster. Head appears viable and firmly united. c, Lateral view this hip June 26, 1933. There appears to be every evidence of fair position of the head and bony union to a live head. Had been walking on capter more than a month. One year later walks very well, slight pain but no change in roentgenological findings.



Fig 6 Heavy male, 40 years old 6 months after an attempted fixation of neck fracture. The trochanteric portion of the bone was pushed up by weight bearing on an unrecognized fracture and lay completely posterior to the head. Operation for bone graft into the head was planned and started. Difficulties in freeing the trochanteric fragment and hemorrhage led to shock and abandonment of operation when only a side-to-side contact had been obtained. This film represents the condition 2 months after removal from plaster and after weight bearing in a willis caliper. He has no pain, a fair range of motion and no change in position. Apparently a union by lateral contact only without proper apposition to a viable head.

The principal points of interest have been in the behavior of the head of the bone after fracture, the changes developing in it or its covering cartilage resulting in interference with blood supply, aseptic necrosis, revascularization and substitution for dead bone by newly formed bone. Studies have also been made of resulting changes in cartilage of the head of the femur and the acetabulum involving slowly progressing loss or deformity of cartilage over areas of dead bone, with replacement by bone from the subchondral areas, or complete collapse depending on the length of time or the amount of unwise weight bearing permitted after fracture. Observation of patients over long periods of time coupled with roentgenological investigation has advanced our ideas of prognosis and treatment and supplemented the information gained in other branches of the study. The fate of the head separated from the neck, or attached to it in proper approximation can be followed and foretold largely by its complete or partial change of density as compared to neighboring bone. This information, however, still leaves something to be learned about the fracture. One cannot say in the early weeks after fracture, even in an average adult or adolescent to say nothing of a senile person, whether the

head in a given case will die and yet unite to the neck, or live and unite and later break down to flatten and slowly disintegrate, after hope had been advanced of a perfect restoration. It is this great uncertainty of the fate of the head and its subsequent mechanical changes which hold this fracture in the unsolved class.

From the studies of Santos, Phemister, myself and others it is known that 4 general results are to be obtained—a dead head with no union, or a real union (which is rare), a live head with no union, or a non-union (which is far from uncommon). In his recent report Phemister states that he has seen 49 patients at varying periods after fracture following different methods of treatment of whom 17 had heads which were alive, 8 with union, 9 with non union. There were 32 cases of complete or partial necrosis of the head with union present in 4 and non union in 28.

Pleat formation and other cartilage changes incidental to disease as described by Freund are not found after fracture, but replacement of cartilage and finally pannus formation with adherence of the head fragment in the acetabulum are seen. True ankylosis of the hip joint has been found after a healing of the neck of the femur.

Roentgenological investigation has covered a study both of the patient's bone *in situ* and of the specimens removed, coupled with the summary of the pathology and histology present. The most recent X-ray advance has also done much from the popular standpoint to influence treatment.

Every surgeon should know, however, that not only the amount of union between head and neck can be shown on the X-ray film, but that even more important information can be conveyed. The film must show both hip joints and the adjoining parts of the pelvis. The amount of regional atrophy about the fracture, a natural sequence of the injury and loss of activity, the changes in the head showing by retained original density or by mottling whether the head is entirely or partly dead or is undergoing bony replacement, along with changes in configuration indicating flattening or collapse or cartilage changes may all be read from one film. The future of the fracture from the standpoint of union to live or dead



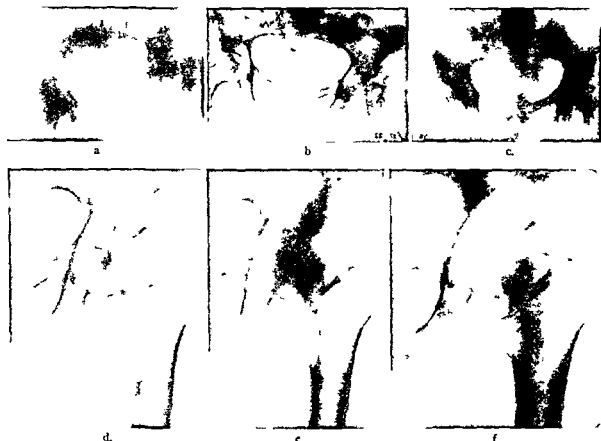


Fig 8 a Fracture of neck in a 35 year old woman. Seen reduced and put in plaster within 2 hours after accident December 10, 1931. b Same patient both hips in plaster December 2, 1931. Replacement apposition angle of neck all seem good. c, Same hips April 11, 1932 just out of immobilization. Apparently good union to live head. d Same fractured hip June 6, 1932. Union good and head viable but neck seems to bend a trifle. Has never borne any unsupported weight worn caliper constantly. e Same

hip September 1, 1932. Evidence of bone absorption upper edge of neck. Head outline good union persists. f Same hip November 1, 1932. Head mottled a little as if bony replacement were going on in it. Neck a little depressed with evidence of absorption pots upper edge. g (See opposite page.) Same patient, both hips, December 1, 1932. Has constantly worn caliper and not returned to work. Head fragment definitely depressed and denser than that of other femur. Outline slightly oval.

favorably on the Hotz-Richard method of nailing through neck of the femur into the head and on into the pelvis. For delayed union Hey Groves advises taking the head out and bolting it on by a bone peg before reinsertion in the hip joint, violating one of the sacred sources of blood supply to the head via the ligamentum teres.

Manipulative reduction with subsequent plaster-of-Paris dressing has held the most adherents and has shown, in statistical review of well handled series of cases by such men as Stern, Henderson, Campbell, and others, good results in from 60 to 70 per cent of the cases. Cotton has amplified manipulative reduction

by artificial impaction to drive the fracture surfaces together with a hammer, striking on the trochanteric area in the axis of the neck after approximation of fractured surfaces. In spite of these methods of treatment the percentage of unions with retention of live heads in patients surviving taking all ages into consideration does not satisfy Darrach and Stimson in a series of their cases found by checking with lateral roentgenograms a high percentage of inaccurate appositions which they feel may explain an unsatisfactory percentage of bony unions heretofore obtained.

Union to a live or dead head does not always follow the quite exact approximation which

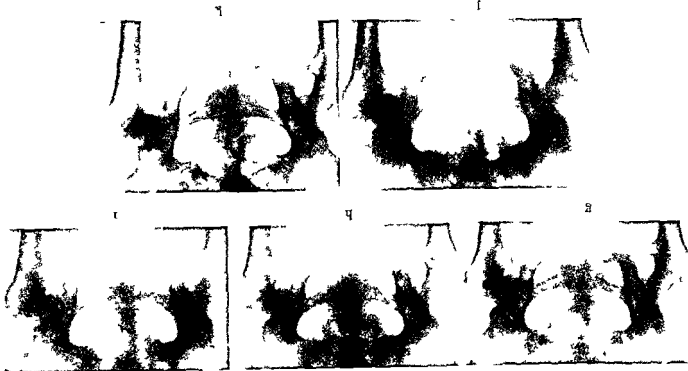


Fig 8, continued b, Same hips March 1 1933. In creasing depression of head and neck, with mottling, union still present 1, Same hips September 1, 1933. Head has increasing density and is flattened. Union persists (all per removed as patient refuses to wear it longer. Cannot work and walks with limp but has no pain. 3, Same hips December 4, 1933. Neck flattened down to a right angle. Considerable restriction of motion in hip joint with definite shortening of leg. 4, Same hips September 17, 1934, with

epiphyseal separation. These changes have occurred when apposition of fracture surfaces has been most satisfactory, they are evidently either an expression of further progress of the unknown pathological changes present in the epiphysis before the separation, possibly leading to changes comparable to those of senility or of too early functional use of the newly healed bone.

Weight bearing or pressure which exists on the head of the bone from the very moment of reduction, or continues on the active process of attempted bone healing, is the one factor which seems undeniably as leading to delayed non-union, aseptic necrosis of the head, and deformity of the hip with joint changes. If we concede that it is largely pressure which causes absorption of the neck after untreated fracture, a similar pressure may act unwardly after reduction with Whitman's method too early display of force against the capital portion of the bone as yet unable to withstand it, on account of internal vascular changes. It

must be aimed at in every case, whether obtained by manipulative, artificially impacted or operative means. When the head gives warning that it is to die, becoming aseptically necrotic in part or completely, one cannot wonder at failure of union, no matter how exact is reposition. In some individuals the trauma of fracture, the loss of or even temporary interference with blood supply add weight to the destructive processes already set up in senile bone, upsetting its physiological equilibrium and leading to its necrosis with subsequent absorption when the patient survives. It would be expected that these factors would not affect the proper healing of adolescents bones which are still in bone-building. Yet some instances of this fracture in relatively young individuals lead to dead head and non-union, in the adolescent, death and degeneration of the head—in appearance strikingly similar to Legg-Perthes' disease—may come on months after an apparent bony healing of



a

Fig 9 a Recent fracture of neck July 19 1928 in a 53 year old woman This occurred during an attack of sleeping sickness exact date was concealed by attendants as she may have been allowed to fall out of bed Head appeared viable compared to the other femur b Same hip December 5 1928 Operative reduction was performed the edges of the two fragments cut back with a chisel and surfaces fitted together in exact apposition under the eye Eighteen weeks in plaster followed then walking in a caliper c Same hip February 3 1929 Head appears viable and union firm Joint space seems narrowed but function very good d Same hip January 9 1932 at least 3½ years after fracture Solid unyielding union to live head If a bone transplant screw or device other than simple replacement after freshening had been employed credit for final union and live head might have been given the internal plant This case makes one doubt the necessity and possibly the value of any mechanical internal fixation



b



c



d



a



b



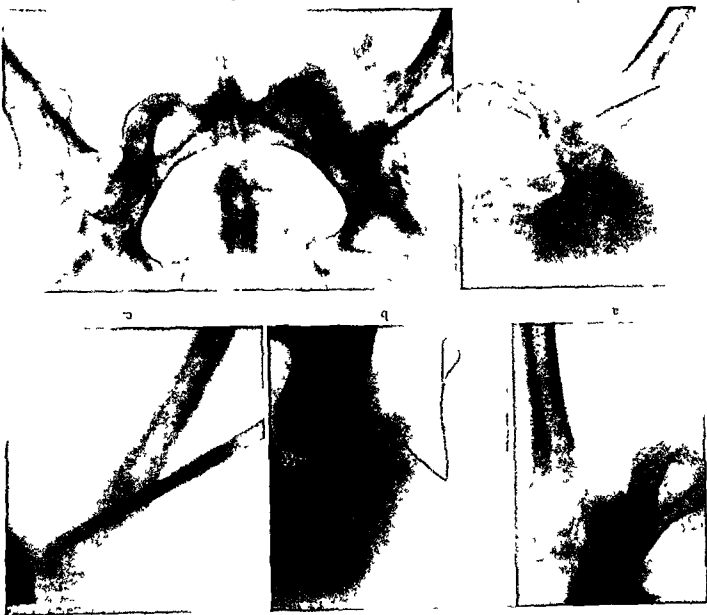
c



d

Fig 10 a Neck fracture September 16 1933 in a young woman 10 years old 7 months after injury She had been given 6 weeks immobilization in plaster Non union to a live head with much pain and disability b Same fracture after operation June 20 1934 Surfaces had been freshened and held by autogenous bone graft After 18 weeks in plaster she was allowed to walk in a caliper Head alive union apparently promised c Same neck August 24 1934 Union seems sustained no depression of neck head viable bony trabeculae developing across fracture plane Still wearing caliper Prognosis very good d Lateral view of the preceding figure same date August 24 1934 A indicates healed fracture plane and B the imbedded transplant





c

d

impaled on the end of the drill. d. Same date after operation, encased in plaster of Paris. Bone transplant taken from the tibial cortex (which seems very thin here, probably on account of the preceding 5 months in bed) has been thrust into the head along the drill tract. Position satisfactory. e. September 25, 1934. Just out of plaster after 18 weeks. Position same as at operation, head a little mottled, union seems started at least, as there is evidence of callus at fracture plane. Was this all due to the implantation of the bone? Will the head retain vitality or will it go on to a complete replacement, and for how many months or years must weight bearing be guarded?

is also possible that too early or too great pressure, as from unguarded weight bearing in walking, interferes with the long period of time required for the return of the bony lamella to their full maturity—a time varying with different individuals—and leads to a reversal of the healing process and an absorption with necrosis of the bone. Some of these changes are irreplaceable either by time or method of treatment, including greatly prolonged freedom from weight bearing, but not from active motion, which is no doubt beneficial

Fig. 11. a. Fracture of neck 5 months old in a heavy woman of 49 years, May 12, 1934. She refused offers to be put in plaster with reduction in January 1934. Non union, pain, never been out of bed. Viability of head questionable b. On operating table May 25, 1934. Through a small anterior incision hip joint opened, fracture site exposed and freshened, reduction and abduction. End of a small flexible probe introduced between fracture surfaces as guide to drill for hole to carry transplant. c. Same date as preceding, still on Hawley table. Using probe as guide, the drill has been inserted below the greater trochanter and advanced across the fracture plane, striking the probe, to enter the head fragment which can be seen and felt to move



Fig. 12. Left 2 years after fixation of recent neck fracture in an elderly woman patient of Dr. Hugh McKenna. Union to a live head seems present. Right 4 years later. Union has held, head has broken down and flattened. Cartilage collapsed, bone transplant still unabsorbed but welded to rest of femur. Did tran plant cause original union? Did it interfere with circulation in the head coming from the ligamentum teres? Did the head die and fragment on account of weight bearing after several years?

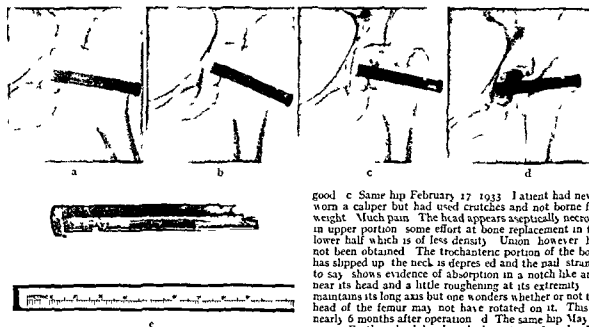


Fig. 13. a Repair of fracture of neck in a woman 53 years old by means of the Smith Petersen nail. The fracture occurred August 21 1932 nail was inserted August 24 1932. From the service of Dr. Phemister at the University of Chicago Clinics. b Same patient. This film taken when plaster was removed on October 26 1932. Apposition angle of neck and penetration of nail all very good. Head appears slightly denser than surrounding bone with well rounded outline and not spotty. Prognosis

good. c Same hip February 17 1933. Patient had never worn a caliper but had used crutches and not borne full weight. Much pain. The head appears aseptically necrotic in upper portion some effort at bone replacement in the lower half which is of less density. Union however has not been obtained. The trochanteric portion of the bone has slipped up the neck is depressed and the nail strange to say shows evidence of absorption in a notch like area near its head and a little roughening at its extremity. It maintains its long axis but one wonders whether or not the head of the femur may not have rotated on it. This is nearly 6 months after operation. d The same hip May 2 1934. Further dead head and absorption of neck. Increased absorption of the nail elevation of the trochanter non union to a dead head. e, Nail removed from patient. Its absorption and partial disappearance affect its stability as a fixation agent to a certain extent. If the circulation in the head has been so poor that death of it resulted was change in nail caused solely by mechanical stress, or by action of cells or chemical agents in blood serum? Lowering of blood supply after fracture in the head in living human may not be so great as we suspect.

- The average percentage of union is probably higher than it was 100 years ago, but in comparison to practically all others this fracture remains unsolved. Our organization might advantageously provide for a corps study of this lagging fracture. Such a study should lead to the adoption of a more or less orthodox line of care for the recent fracture, consisting of gentle reduction by traction, inversion and adjustment of the trochanteric portion of the femur to fit its displacement, followed by a reduction to the degree indicated in the pre-reductive roentgenogram as necessary to restore the angle of the neck and coaptation of fractured surfaces. This reduction would be maintained by immobilization in plaster of Paris. Such a method would be practiced by most surgeons. A few might prefer to treat their patients by operation very soon after fracture, employing selected methods in an attempt to minimize the period of immobilization and to avoid feared complications. All methods should be subject to proper X-ray control for position and progress of healing. The convalescent period must be guarded by adequate support of the fracture plane not only during the healing and re-forming of the bone of the neck but also during the first months after release from immobilization when weight bearing is begun. At the present time there is no guarantee of 100 per cent cure. The secondary changes in hip joint and femoral head still occur, caused, possibly, by vascular deficiencies or other unknown factors following even in the face of most satisfactory replacement and apposition by any method in vogue, with a supposedly proper period of immobilization and freedom from weight bearing. Apparently they are immediate results of the fracture or its treatment, but they seem uncontrollable by present methods of care. The fracture is still unsolved.
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## STERILITY, WITH SPECIAL REFERENCE TO SURGICAL POSSIBILITIES<sup>1</sup>

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*Vae dulces natos veneris nec praemia noris (Virgil Aeneid IV)*

THERE have been efforts to divorce gynecology from surgery and surgery from obstetrics but it has always been our opinion that obstetrics and gynecology should go hand in hand and that the practitioner of these subjects should be able to cope with any of the ordinary surgical complications which may arise in his practice. In other words, let not the women of the world be dependent for their consultants in obstetrics on practitioners who are gynecologists and who only "do obstetrics in private practice." A great deal of gynecology is due to bad obstetrics, and the good gynecologist may make the future confinement a safe procedure, whereas the ignorant gynecologist may leave the organs in such a position that dystocia is bound to occur.

What is the surgical subject most allied to obstetrics? Some might say plastic vaginal work. We believe that the link between obstetrics and gynecology lies in the attempt to cure sterility. When this subject was chosen we found we were rushing into a hornet's nest from which we were inclined to run for we were well acquainted with the Meaker clinic in Boston, but sterility has been our close study for upward of 25 years, so we decided to adhere to our decision.

It is not intended to go through the whole gamut of the subject, it is not intended to produce a bibliography, this is being done every day it is hoped to deal briefly with certain aspects paying especial attention to the surgical side.

Sterility is a disease it is a disease which can bring misery into the home. The craving for a child may become a worse disease than anything else in the world. A patient of ours has remarked, "I would not mind dying if I could only have a child."

It has been suggested that "after sterility" can be prevented by care in the premarital state surely this must be so and if girls are taught the principles of health and hygiene the future mothers of the nation will be able to fulfill their duties. The man and woman about to marry should be taught what healthy marriage is they should be given one of the simple and scientific books on the subject, not some of the suggestive trash which is being published by even reputable firms at the present time. Ignorance of the sexual functions has produced in our experience, much sterility.

A word only must be mentioned about contraception. When advice is sought on this subject it is given, but a warning is uttered

<sup>1</sup> Presented before the Clinical Congress of the American College of Surgeons Boston October 17 1934

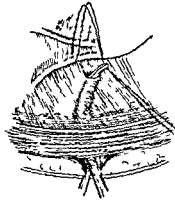


Fig 1 Author's subperitoneal Gulliam operation, first stage

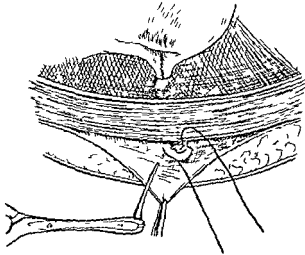


Fig 2 Author's subperitoneal Gulliam operation, second stage

misuse of contraceptives about the possibility of sterility following the

A marriage should not be considered sterile until after 18 months. A woman should have no gynecological treatment for sterility (unless there are very definite other symptoms) until after 18 months. We agree with those writers who have found that about 30 per cent of cases of sterility are due to the male. In the male, the most common causes are ignorance, impotence, excessive coitus, misuse of contraceptives, frigidity, and absence, paucity, or abnormality of the spermatozoa. As already stated it is not proposed to delve fully into all aspects of this subject. Suffice it to say that the sterile patient must be carefully questioned about her general health and her habits as well as her gynecological history. It would be an interesting study in this land of America to find the effect of alcohol on fertility. The sages of old were wise, and it may be remembered that the mother of Samson took a vow of temperance previous to the birth of her child. Are the babies stronger with or without prohibition?

At a not very far distant date hormone therapy will be simplified. A separate paper could be devoted to hormone therapy in relation to sterility. The subject cannot be ignored nowadays. The effect of diet and thyroidic hormones on the obese patient with scanty menstruation is dramatic in many instances. The diet without the drugs, or to the singer without the orchestra. At variance with other writers we have had much success in cases of hypofunction with scanty

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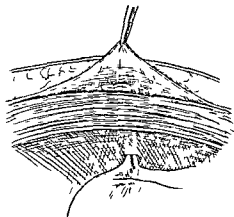


Fig. 3 Third step in author's subperitoneal Gilman operation

Suggestions have been made by some that any manipulation of the cervix is futile, by others that very radical measures are necessary. We have had in our own practice examples of pregnancy after the passage of the uterine sound and this is especially notable where there is a definite plug of mucus present—usually more than this is required. Dilatation of the cervix with some modification of Hegar's dilators or gradual dilatation by means of sea tangle tents is followed in numerous instances by pregnancy, provided there are no other pathological conditions present.

It has long been a matter of dispute as to which of these latter methods is the better, and we are so frankly agnostic that we use each procedure in 50 per cent of our cases with somewhat similar results. The great advantage in the tent method is that when the Rubin technique is used and the tubes are found to be normal no anæsthetic is necessary for the introduction of the tent.

We have discontinued altogether all such operations as anterior division of the cervix, posterior division of the cervix, Pozzi's operation. We tried them for many years—a thorough dilatation is safer. Dilatation is continued until just before the start of tearing, i.e., until it is believed that the next dilator will tear the cervix. The danger of all such operations as those mentioned is that unless performed with meticulous care a scar will be left from which leucorrhœa may exude, a condition most inimical to the spermatozoa.



Fig. 4. Blowing up the fallopian tube with air

The only other operations on the cervix worth mentioning are trachelorrhaphy to cure old tears in one child sterility and the removal of erosion by means of cautery or amputation. A careful operation to cure erosion will stop leucorrhœa and will often cure a long standing one or two child sterility.

*The body of the uterus.* Backward displacement of the body of the uterus is a very real cause of sterility. Such displacements as retroversion with acute ante flexion, and ante version with acute ante flexion are congenital malpositions associated often with hypofunction and dysmenorrhœa. Apart from dilatation of the cervix, no surgical measures are required; hormone therapy will help. The displacements which really concern us are retroversion usually associated with retroflexion with or without adhesions. The cure of these displacements often means the cure of sterility and a good prognosis may be given. To deal, first, with retroflexion without adhesions, most of the women who consult us have no complaint except sterility. They are young women for whom pessary treatment is inadvisable in fact very often the presence of the pessary acts as a bar to conception and operation is much to be preferred. Having done a Rubin test, followed by dilatation of the cervix, a subperitoneal shortening of the round ligaments is performed.

Since various operators seem to differ as to the best technique the operation is described and illustrated (Figs 1, 2, 3). It is safe as to immediate and remote prognosis. It cannot cause intestinal obstruction or dystocia. It must be especially stressed that fine silk is used as recurrences have been encountered.

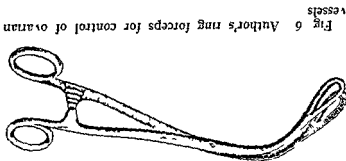


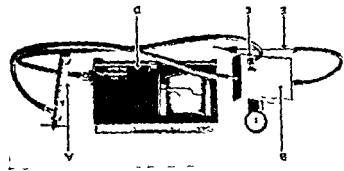
Fig. 6 Author's ring forceps for control of ovarian vessels

When adhesions are present, they are broken down. If the adhesions are complicated by tubo-ovarian trouble, these are dealt with. If the appendix is pathological, it is removed.

The question of the removal of the appendix must be carefully considered. Appendicectomy in some unknown way has cured sterility, or, rather, a woman who has been sterile has become pregnant after that operation. Whether the vestigial peritoneal band, the ligament of Clado which connects the appendix and right ovary has anything to do with this is quite impossible to decide. Appendicectomy raises the morbidity following gynecological operations, after manipulation on the tubes it is better to leave the appendix alone. Therefore the technique, if appendicectomy is contemplated, is that this organ should be examined and removed before any attempt at salpingostomy is made.

Apart from displacements, fibroid tumors will cause sterility, for they may act as mechanical impediments especially if in the neighborhood of the cervix or they may cause ovarian dysfunction. The gynecologist should spare himself no trouble to enucleate myomata, for their removal often means a sure cure of sterility. We have taken away a single myoma the size of a fetal head including portion of the uterine mucosa. We have removed multiple myomata and the results are very gratifying. It is very important in all cases to avoid the risk of postoperative adhesions should be avoided in case of sterility. Every effort must be made to have the uterine scar on the anterior surface of the uterus. If it must be on the posterior aspect, the scar should be covered with an omental graft. We do not suggest taking risks. If myometomy appears in the opinion and from

Fig. 5 Author's combined instrument for testing tubes and kymograph



after the use of catgut. The operation is done as follows

The abdomen is opened in the mesial line from the symphysis pubis upward. Adrenal abnormalities are corrected. A stitch of No. 2 silk is placed about the round ligament on each side from 1 to 1½ inches (depending on the size of the uterus and the lengthening of the ligament) from the uterine cornu, this stitch is not tied, silk *must* be used, if catgut is the material, a recurrence of the displacement will occur. A clip forceps is placed on the edge of the rectal aponeurosis on a level with the top of the fundus uteri. A curved forceps is then passed under the aponeurosis between it and the muscle until it reaches the outside margin of the peritoneum. The forceps is then passed outside and behind the peritoneum, and is brought inward until it reaches the stitch which has already been placed about the round ligament, it pulls this through. A Reverdin needle is then passed through the under surface of the aponeurosis at the outer margin of the rectus muscle, threaded with one end of the ligature, which is drawn through these structures, the same is done with the other end, and the stitch is tied. The curved forceps may be passed through the internal abdominal ring, but there is no need to look specially for this point. The uterus is thus suspended in position by subperitoneal shortening of round ligaments, hence, no danger of intestinal obstruction. The silk is first steeped for 24 hours in ether and then for 24 hours in alcohol. After that it is boiled for 20 minutes and stored in 1,000 mercuric perchloride.

the experience of the operator to be too great a surgical risk, hysterectomy must be chosen, but the risk of labor after myomectomy need not be considered

*Ovaries* Ovarian tumors large or small should be removed when the patient is sterile. The sterile woman with mid menstrual pain associated with sterility can sometimes be cured of both by bimanual bursting of the graafian follicle under anæsthetic. If this does not cure we have after laparotomy shaved the surface of the ovary and closed the abdomen. This seems to allow an easier extrusion of the follicle. We have performed ovarian grafting in a few cases of hypofunction in the hope that the graft would stimulate ovulation. So far we have had no cures of sterility in this type of case.

*Adhesions* Special attention must be drawn to this cause of sterility. When there is no abnormality discovered on bimanual and tube examination and the husband and wife are both normal it is worth while to open the abdomen. Adhesions of the tube or ovary to the broad ligament or pelvic wall are sometimes present. Apparently the normal path of the ovum into the tube is interfered with. The separation of these adhesions is followed by pregnancy in a sufficient number of cases to justify the procedure.

*The fallopian tubes* The question as to the advisability of operating on the fallopian tubes for sterility has been a bone of contention for many years. This bone has been nearly picked dry but as we are especially interested in this particular phase we intend to try to pick a little more meat from it.

We do not intend to expound to any great extent on the anatomy of the tube but attention must be drawn to several points.

1 The wall gets thinner as it is traced outward from the isthmus to the infundibulum at the same time the lumen gets broader. This thinness makes it easier to form a cuff in the tube during a salpingostomy at the fimbriated end, but sutures are a little more apt to tear out. The larger lumen makes pregnancy more likely here after salpingostomy.

2 The interstitial portion of the tube contains more connective tissue and is therefore less elastic and possibly less favorable for

pregnancy than the other portions. The fact that there are two definite layers of muscle, the longitudinal and circular, makes for no difficulty in resection.

3 A very important fact in anatomy is the arrangement of the mucosa in permanent long folds which are simple in their inner portions but become more and more complicated as they reach the fimbriae until their appearance simulates glands, but true glands are absent. In the event of a single inflammatory attack, the glueing together of the tubal walls becomes a very real possibility. It may be well to recall that Curtis some years ago showed that a slight manipulation in the cervix may produce a temporary infection in the tubes.

*Cyclical changes in the tubes* Novak and Everett have made this subject very clear and showed that the tube is derived from muellerian epithelium and takes part in the cycle of menstrual changes. It is especially noteworthy that the postmenstrual phase is characterized by low epithelium which quite rapidly increases in height. It seems therefore a favorable time for tube testing, salpingography, and salpingostomy.

After these introductory remarks, we must consider how to deal with the diagnosis and treatment of the tube in its relation to sterility. In 1909, when our interest was aroused in the subject of sterility, if a dilatation of the cervix or a dilatation of the cervix with curetage failed to cure, we could only recommend laparotomy in order to diagnose closed tubes in those cases in which palpation diagnosis was impossible. The abdomen was then opened. If the tubes were blocked, salpingostomy was done. If they were patent, they were blown up from the abdominal ostium with a large ear syringe (Fig. 4). Pregnancy often followed. Now Rubin's great work on insufflation and salpingography has prevented the necessity for laparotomy in numerous instances in which it was imperative before.

It has been well said that there is nothing really new under the sun, and without wishing to take the slightest credit from Rubin for his wonderful methods which have brought happiness to many a home, the following quotation from the Aphorisms of Hippocrates, vol. ix, must be given.



1 The operation should never be undertaken in the presence of pyrexia, in other words, the infection should be chronic. Care must be taken to ensure that there has been no recent exacerbation of a chronic condition. We have had no trouble about this by adopting a routine sedimentation test in every case. The simple Linzenmeyer technique is used, i.e., 1 cubic centimeter of blood is drawn into a syringe and mixed with a few drops of a 5 per cent solution of sodium citrate. If the blood settles in any time under 30 minutes, the operation is not done.

2 If there is any likelihood of tuberculosis the operation should not be done.

The operation is difficult to determine. The presence of tuberculosis is difficult to determine. All efforts to obtain a history of tuberculosis usually end in failure. The patient refuses to acknowledge a tuberculous diathesis. A close inquiry into the family history may elicit the fact that the father, mother, or a brother, or sister has suffered from the disease. Such signs as scars on the neck may help. Symptoms of tuberculosis of the tubes are more often absent than present, heavy menstruation is about the only notable feature. Such old tests as the Calmette and others were tried in many cases but they were found to be of little help. And even when the abdomen is opened, it is still impossible, in a large number of cases, to say if the patient is tuberculous or not. The obvious cases speak for themselves, i.e., the mass adhesions, tubercles on the peritoneum, etc.

What should be done if the patient is known to be tuberculous? If there are masses of adhesions and tubercles pervading the abdominal cavity, it is obvious that efforts to remove the tubes will cause escape of pus and leave raw surfaces difficult to peritonealize, the patient should be left alone and radium or X-ray applied later to the abdomen if ascites or troublesome symptoms arise. If, on the contrary, the removal of the tubes will be a simple matter, the idea of curing sterility is abandoned and salpingectomy done, taking care to core out the interstitial portion from the uterus. In our early work, we tried salpingostomy for tuberculosis of the tubes, but never saw pregnancy follow in a single case known to be tuberculous. The radical operation

If a woman does not conceive, and you wish to know if she will conceive, cover her head with wraps and burn perfume underneath. If the smell seems to pass through the body to the mouth and the nostrils, be assured that the woman is not barren though her own physical fault.

This test seems to be the forerunner of the Rubin apparatus.

It is not intended to go into the details of the Rubin technique. We have followed his methods and got somewhat similar results especially with regard to pregnancies following both the inflation of the tubes with carbon dioxide and with ethidol. The latter has certain advantages over the other opaque substances in common use. It is thinner, seems to cause less pain, and requires less pressure to force it upward.

As we found that glass apparatus broke easily and was not really practical, we had a tin box made with X-ray photograph attached (Fig. 5). This X-ray photograph does not give as complete information as Rubin's excellent instrument, but it helps in giving confirmative information with regard to patency of the tubes or not. A very straight up curve means closure, a wavy curve means lumpy, which can probably be overcome, a gradual curve nearly always means the tube will open at the second or third attempt. We have found especially that a round type of curve is often present in association with retroversion of the uterus. So far, we have not been able to tell the site of occlusion except by definite salpingography.

If the tubes are apparently closed, the patient is left for from 3 to 6 months and if they are still closed, laparotomy is advised. If laparotomy is to be done, an X-ray photograph should be first taken. We use the simplest possible technique, merely a Rubin sound with an attachment at the end in which a record syringe can be inserted and 9 cubic centimeters of ethidol injected. Sometimes after an X-ray photograph a Bonney sound is left in the cervix. When the abdomen has been opened, if there is any difficulty in determining the site of closure, the tubes are blown up with air from the vagina. Under what circumstances should salpingostomy be done? This question is best answered by the query: What are the contra-indications?



Fig 7 Catgut in tube after opening and oversewing ostium

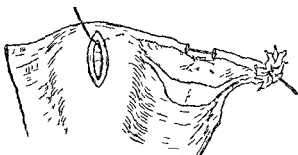


Fig 8 Resection of isthmal portion of the tube

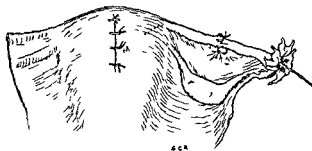


Fig 9 Resection of isthmal portion of tube operation complete



Fig 10 Operation for disease at uterine end of tube and interstitial portion

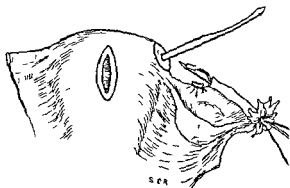


Fig 11 Operation on uterine end of tube and interstitial portion, second step

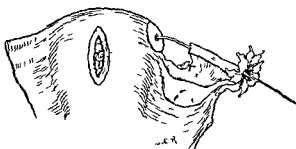


Fig 12 Operation on uterine end of tube and interstitial portions, third step



Fig 13 Operation on interstitial portion of tube

tion is a safe procedure and apparently prevents further spread of tuberculosis in the body. There is no need to do hysterectomy and it is not done unless it makes the operation simpler and safer. We have proved by curettage of the uterus before and after removal of the tubes that the removal of the latter means a cure of tuberculous endometritis. If we are not sure of our diagnosis as to whether the case is tuberculous or not, we

have tried various light forceps but the fingers are the best and safest. Hemostasis is necessary and we use our curved ring forceps (Fig. 6) to control the ovarian vessels.

(a) *The tube closed at the abdominal end,*

(b) *by adhesions.* This is the simplest case to treat and is attended by best results. The adhesions are separated and the ostium examined. If there is any bleeding surface, a plate of No. 4 Luken's catgut is inserted in the lumen to prevent adhesions reforming. At the suggestion of Tweedy, the insertion of catgut in the tube during these various operations has been done by us for the last 20 years and numerous varieties of technique have been tried. It is a routine procedure and the tubes have been demonstrated patent in certain cases where it seemed impossible that they could keep open without this measure.

(b) *Disease in the tube.* This is usually a chronic condition following gonorrhea or some postabortive or puerperal infection in the one child sterility case. It is sometimes necessary to remove a portion of the fimbriated end. The following is then done all bleed-

ing is controlled, the raw edges are oversewn, and a plate is inserted (Fig. 7). Occasionally we have made a definite cuff by rolling back a portion of the tube, but a mere oversewing of the tube shows better results on testing.

This can be felt and has been shown by salpingography. The following operation is performed (Figs. 8, 9). The vessels in the tubal mesentery are tied, the diseased portion is removed without clamping the tubes, a piece of catgut is then passed on a long needle from the fimbriated end through the uterine ostium, the uterus is split, and the catgut knotted in the cavity. The endometrial surfaces are approximated, the uterus is closed and an end-to-end anastomosis is done on the tube.

If it is certain that the catgut will remain in the tube at the site of anastomosis, it is passed to the uterine ostium and the anastomosis completed without splitting the uterus. Kinks alone in the isthmus can sometimes be loosened digitally or by snips of scissors. It is well in this type of case to have Bonney's sound in position to blow up the tubes while

treat it as non-tuberculous and try resection. If trouble ensues later the remaining portion of the tube can be removed.

*The cases suitable for salpingostomy.* In spite of the paucity of successes after salpingostomy in certain portions of the tube, it is our opinion that the operation should be attempted for all women who want to try the last resource. The tragedy of sterility may be great and even if, as will be shown in results, the percentage of success is small, we must hope that improved technique will bring about improved results and if there are any successes at all the women must be given the chance, however small it may be. Then one can say—"All has been done that is possible if there is no result and you want a baby, adopt one." Alternatively, one can say, "This operation I am about to do has a very small percentage of results, will you have it done or will you adopt a baby?"

Our opinion, that an effort should be made to cure tubal sterility, is shared by many. It is scoffed at by others. Like many techniques, success apparently can be obtained by some practitioners and not by all. The careful choice of cases, the gentle handling of the tubes, meticulous attention to detail, all count. Various techniques have been tried. Splitting of the tubes and gouging out the uterus, as well as other numerous suggestions that have been made, have not been successful in our hands.

Success should be measured, not only by the number of pregnancies but also by the patent tubes after salpingostomy.

In considering operations of the tube, we divide our cases into the following varieties:

A (1) Closed at abdominal end of the tube by adhesions, (b) by some disease in the tube.

(2) Tube blocked in some portion of the isthmus (a) by kinks, (b) by disease of the tube.

(3) Tube closed in the interstitial portion (4) A combination of any of these (5) Tubes closed by hydrosalpinx.

B Too long tubes.

C Too narrow, but patent tubes.

As already stated, a very important point in technique is the handling of the tubes. We

the abdomen is open to ensure that they are really patent. Alternatively, ethiodol can be injected from the vagina and can be seen distending the tubes and in the case of open tubes appearing at the abdominal ostium.

*Tube closed in the interstitial portion* (Fig 10) The following technique is practiced. All bleeding is controlled, the tube is cut away from its insertion into the uterus. If the tube is healthy, catgut is passed through it as above described. It is then determined that the uterine ostium is open—a sharp knife is used to shave off uterine muscle until the ostium is definitely exposed. The tube dilators which are really modified lachrymal duct dilators are now brought into action, and the uterine ostium is dilated up to the largest size. The anterior wall of the uterus is now split in the midline (Fig 11). The catgut is passed through to the cavity and knotted (Fig 12). The endometrium is approximated by fine catgut sutures and the muscle wall closed by interrupted catgut sutures. The cut surface of the tube is now sutured to the uterine ostium. If the tube is diseased, it is removed and the uterine ostium is exposed, it is dilated and a strand of catgut is inserted, a new ostium formed and the ovary brought near to this new ostium (Fig 13).

*Hydrosalpinx* In this a special technique is practiced. The abdominal ostium is opened, the fluid milked out the edges oversewed, and catgut inserted in the lumen.

*B Too long tubes* It has been suggested that sterility may follow excessive length of the tubes. In early days in intractable cases without obvious cause for the sterility, a portion of the tube was removed but the results in no way justified the experiment.

*C* We have noticed what appeared to be great narrowing of the tubes although patent. This is apparently a very real cause and is a matter worthy of investigation. Hormone treatment is worth a trial.

It is not intended to give here the statistics of the many thousands of sterility cases which have come under our notice. Cure is easily obtained in many of them. The cures following ordinary common sense advice, the dramatic cures following the passage of a sound but especially the passage of carbon dioxide

or some opaque substance through the tubes, the cure of backward displacement, the very usual occurrence of cure following both small and extensive myomectomies, are common to the practice of all of us. In a paper such as this, one would like to welcome a new comet on the horizon of gynecology one which would diffuse the light of knowledge in regard to the cure of sterility after salpingostomy, but that comet, alas, is still in the womb of time. Our cures are few, in spite of all efforts, yet they are enough, we believe, to justify a further trial of the methods of tubal resection.

We have sent a questionnaire to 366 patients who have had tubal resections, but many have not replied, and rightly and wrongly we have marked them off as failures. There were 28 pregnancies. The operations were as follows:

Eighteen resections at the fimbriated end  
Four resections at the isthmus  
Six resections in the interstitial portion.

In addition, there were two tubal pregnancies both after isthmal resection. Of the remaining 336 cases, patency was obtained after tube testing, but no pregnancies resulted in 68. Of these:

56 were at the fimbriated end  
4 at the isthmus  
8 in the interstitial portion.

To sum up the statistics of 366 cases of tubal resection. There were 30 or 8.2 per cent which became pregnant and 98 or 26.5 per cent which either became pregnant or showed tubal patency after operation. Should we then advise our patients to submit to this major operation? Our answer is that the pros and the cons should be explained to the patient, and if she leaves the decision to the surgeon he should operate. Although the cures following tubal resection are not more numerous, I conclude with the hope in my heart that this paper may inspire others to make experiments which will bring about improved technique, followed by success in a large percentage of cases.

*Dum spiro, spero!*

#### SUMMARY AND CONCLUSIONS

1 The paper is the result of the study of many thousands of cases of sterility.

- 6 The statistics of cures following such procedures as dilatation of the cervix, insertion of the tubes, cure of backward displacement, myomectomy, etc., are not given in this paper. Cure in such cases is easy to obtain.
- 7 The treatment of tubal sterility is discussed. The technique of operation is described. The results of 366 operations are given.
- 8 After separation of peritoneal adhesions laparotomy. Cure of sterility has resulted in normal, it is worth while performing and closed tubes, when the patient is otherwise normal.
- 9 In the absence of displacements, tumors, should be discouraged.
- 4 Such operations as splitting of the cervix, effects cure.
- 3 Hormone therapy when properly carried in puberty and in marriage.
- 2 Sterility can be prevented by instruction

Dr Louis E. D'Amour, Boston. The problem of sterility is such a complex one, that the surgical side of the question is but one part of it. Since Dr Solimons has limited his remarks to the surgical possibilities as they apply to the female, I shall confine my discussion to that particular phase of the subject.

When the rigid intact hymen is a cause of sterility, a simple dilatation under anesthesia may be sufficient, while in some instances, in the presence of severe vaginitis and dyspareunia, operation becomes necessary to enlarge the vaginal introitus.

Tumors of the vulva interfering with normal coitus should naturally be excised.

Theoretically, at least, stenosis of the cervix should not play an important role in the etiology, since it seems logical to feel that if there is sufficient room for the passage of the menstrual discharge, there should be no obstruction to the ascent of the mobile spermatozoa. Endocervicitis, however, as a sequela to lacerations and infections, with the resulting plug of mucus clogging the spermatozoa, is responsible for sterility in many instances. Like Dr Solimons, I feel that anterior and posterior incisions of the cervical dilators to the safe angle tents, if the cervix has to be dilated.

Endocervicitis, in my hands, has been treated successfully by coining the endocervix with the high frequency current, the Hyman electrode being used. This is an office procedure, carried out under local anesthesia. Healing takes place unimpeded by squamous stratified epithelium. I have seen pregnancy follow this method in a number of cases.

Acetone solutions of the uterus, *per se*, are not a serious cause of sterility, although we all have seen, in the absence of other causes, pregnancy follow their correction. In the congenital type of retroversion, where there exists a short anterior vaginal wall pulling the cervix forward, the symptoms, the anterior wall should be lengthened by operation before shortening the round ligaments. With a mobile uterus remaining in posterior position because of relaxed ligaments, I have seen satisfactory results when the

## Discussion

Dr Xavier R. Alvarez, Boston. I remember hearing the late Dr William F. Graves say some years ago that the most hopeful cases of sterility left to me.

personally advise against operation if the decision is be left to the couple under consideration, but I figures, the decision for this type of operation should in full accord with him that in the presence of these or better than those obtained in most clinics. I am so operated, or 76 per cent. His results are as good as Dr Solimons reports 28 pregnancies in 366 women implantation of a resected tube in the uterine horn value of salpingostomy, tubal anastomosis, and the There is a marked difference of opinion as to the taken into account.

conjunction of abundant large tumors should also be danger of hemorrhage and sepsis following the of endometrium in their removal. I have increased numerous, because of the sacrifice of extensive areas results if the tumors have become too large and too tion, obviously, cannot be performed with these—as high as 33 per cent in some series. The operation, followed by pregnancy in a high percentage of cases. Myomectomy, in properly selected cases, has been followed by pregnancy in a high percentage of cases. Uterine fibroids are an important cause of sterility.

defect repair of the pelvic floor will obviously correct this with the cervix long enough to permit the entrance possible for the seminal fluid to remain in contact extensions relaxation of the vagina, making it im lacerations of the pelvic floor may cause sterility, by time of the pelvic operation. Occasionally, marked cysts or even the ressection of certain ovaries at the sterility and would urge the puncture of these small would call attention to cystic ovaries as a cause of these adhesions before suspending the uterus. I Solimons has emphasized the necessity of freeing Rubin test and the injection of iodized oil. Dr though the tubes may be patent as shown by the the tubes and ovaries to the broad ligaments even retrodisplacements, we frequently find adhesions of form of treatment entirely. As a complication of sitting pessary. I would not, therefore, discard this uterine malposition was corrected by means of a well

are those in which the wife presents a pelvic lesion that can be corrected by surgery. The work of more recent years has considerably changed this situation. I should say today that the total benefits of surgical treatment are less than the total benefits of the constitutional treatment, endocrine and other, of one or both partners. Nevertheless surgery continues to play, and always will play, an important part in the relief of human infertility. We are fortunate to have had this opportunity of hearing the subject presented by a man who is recognized as an outstanding authority.

In one minor particular our practice here differs from that recommended by Dr. Solomons. We believe that there is at times distinct value in plastic operations designed to enlarge the os externum. Viscosity of the endocervical mucus, a common and important factor in sterility, is most difficult to correct unless free drainage can be established. Dilatation does not always prove adequate since the cervical muscle quickly regains its tone and in many such cases we do a small posterior median dissection.

Our experience with salpingostomy is not extensive, for two reasons. First we have limited our operations to cases of fibriated end occlusion, feeling that surgery has little or nothing to offer when blockades exist in other portions of the tubes. Second, we have further restricted the number of our operations by doing them only when all factors apart from the wife's tubes are either corrected or shown to be easily correctable. Under these conditions we have performed nineteen salpingostomies, with insufflation of gas and injection of oil as routine items in the after care. Ten of these patients have

conceived, one pregnancy was ectopic, and one woman has had two babies, so that the total result of the nineteen operations is eleven pregnancies, producing ten normal living children.

There is another type of surgical procedure to which we attach considerable importance in sterility. I refer to conservative operations on the ovaries, designed to remove mechanical impediments to ovulation, particularly retention cysts. One encounters some difference of opinion as to the value of such operations. It is not impossible for normal ovulation to occur in so called polycystic ovaries, but the observation of a long series of cases has led us to conclude that retention cysts, by creating an abnormal intra ovarian pressure, militate against the maturation and rupture of other follicles, and we believe that the careful removal of such structures increases appreciably the likelihood of normal oogenesis.

I am glad that Dr. Solomons opened his paper by emphasizing the importance of constitutional treatment, and by underlining the ever present responsibility of the husband. I am glad also that he has nothing to say in favor of curettage, for we should appreciate that ablation of the endometrium is scarcely calculated to increase the likelihood of conception. In my opinion the curette has seldom if ever cured sterility, and has not uncommonly caused it.

The whole subject of involuntary sterility is one of major importance, not only from the medical but also from the social and economic viewpoints, since it profoundly affects not less than 10 per cent of the human race. We are greatly indebted to Dr. Solomons for his most timely presentation.



by the usual classification of the condition into obstructive and communicating types. Obstructive hydrocephalus only means that the block is between ventricle and spinal theca. In communicating hydrocephalus the block is farther on in the fluid pathway.

In 44 cases studied completely both before and after death, by Dr Arthur Elvidge and myself one or more blocks, usually adhesive, were found in every case. The difference between them lay in the situation of the block and in its nature. So far as our experience goes there is no such thing as chronic hypersecretive hydrocephalus. The pathological cause does not lie in the choroid plexus.

There is now no valid ground for doubting that cerebrospinal fluid is poured out from the choroid plexuses within the cerebral ventricles. It passes through the aqueduct of Sylvius and fourth ventricle into the subarachnoid cisternæ where it moves forward beneath the brain and outward in the fissures of Sylvius to the subarachnoid spaces over the hemispheres forming the chief absorbing areas.<sup>1</sup>

Although absorption is carried out to some extent in the subarachnoid space over the cerebellum and within the spinal canal and also, no doubt, within the ventricles themselves, the amount of absorption is ordinarily not great enough to accommodate the outflow from the choroid plexus (2).

*Nature of block.* Among infants however, in the great majority of cases the obstruction is due to closure of the cerebrospinal fluid pathways by inflammatory exudate or to congenital failure of these pathways to open up when the fluid first begins to form.

In a group of 26 cases of infantile hydrocephalus reported by Dr Elvidge and myself the condition was evidently present at birth—and may therefore be called congenital—in 17 cases. It was apparent in 7 cases that it developed after birth. In those which were obviously postnatal, organized inflammatory exudate was usually found in the subarach-

noid space. In at least 5 cases it was apparent that an inflammatory process had begun *in utero*, which observation favors the suggestion of Dandy that meningitis may occur before birth. Thus half, probably more, of the blocks are due to infection before or after birth.

*Ventricular dilatation* follows certain well defined rules. In children it begins proximally in the lateral ventricles and marches distally toward the block. If the block is in the basal cisternæ the fourth ventricle and the cisterna magna dilate only after this process has been under way for some time in the lateral ventricles, the third ventricle, and the aqueduct of Sylvius (5). Eventually the whole ventricular system dilates equally.

Furthermore dilatation and local cerebral destruction are much more rapid beneath less resistant areas of the cranial vault. Thus decompressive removal of bone in either an adult or an infant is worse than futile. It results in rapid destruction of that particular area of the brain which has been decompressed with no permanent change in the intraventricular pressure.

*Cerebral compression* results gradually in cerebral destruction but the destruction of the brain due to ventricular enlargement has certain peculiarities. Although the volume of the brain tissue is progressively reduced it continues for some time to function normally, and essential structures tend to be preserved. The white matter of the hemispheres seems to suffer most while the convoluted grey matter uncoils itself with less destruction. The white matter is made up of long nerve fibers each of which may give off numerous collateral branches. As the sheets of white matter are stretched it seems possible that the collateral branches are torn off. This would allow a continuation of essential function and would explain the large numbers of scattered compound granular corpuscles laden with fat that are found within the white matter of the progressively stretching hemisphere.

*Localization of the block* is necessary in any case for practical purposes but certain warnings should be sounded. The passage of an injected dye from one point to another may be of help, Dandy's neutral phenolsulphonphthalein or preferably indigocarmine being

<sup>1</sup> In any normal patient ventriculography or encephalography demonstrates all the details of this pathway over and over again, and verifies the fact that the foramina of Luschka and Magendie are actual passages, not closed membranes except in the rare case (possibly 1 in 10) where air or oxygen will not pass from spine to ventricle. Oxygen in the subarachnoid space disappears completely in an hour or two. Indeed it disappears so rapidly that 30 or 40 cubic centimeters of oxygen—more than the removed fluid—may be injected during encephalography without raising the initial fluid pressure. On the other hand it remains in the ventricles for days.



of that fluid medium. Thus the original interference with absorption may well result in a "vicious circle" of further increase in fluid by arrival at a pressure against which little or no fluid can pass out through the cell walls of the choroid.

That the venous pressure within the intracranial sinuses is greatly augmented in internal hydrocephalus is shown by the appearance of an increased number of dilated veins which appear typically in the scalp of a hydrocephalic infant. These scalp veins are fed by perforating communicating vessels. The cyanotic appearance of the scalp itself in these patients bears the same testimony. On the surface of the dilating ventricle and in the cortical pia as well, vessels increase in number and compliance until the time when the hemisphere wall is reduced to a membrane, when the vessels disappear altogether.

*Therapy.* Certain lines of attack are self-evident. First of all the cause of obstruction may be removed surgically in the case of a tumor. In adults it may be removed surgically also in certain cases of adhesive arachnitis, usually involving the leptomeninges of the posterior fossa. This adhesive condition seems to be inflammatory. In a number of my own cases there has been a history of a previous illness resembling influenza. Clinically the cases usually suggest a pre-operative diagnosis of cerebellar tumor. Separation of a few weaker adhesions results in surprisingly satisfactory relief. It is unnecessary to say that appropriate medication may remove even a complete block in a syphilitic lesion.

*Intelligent therapy calls for localization of the site of the block.* Forty-four of our cases of internal hydrocephalus, which will be reviewed by Dr. Elvidge, were as follows. In 21 cases the block was found to be in the subarachnoid space. In 14 cases the first block was in the aqueduct. In 3 the obstruction was in the third ventricle, in 1 it was of the foramina of Lagenie and Luschka, and 3 cases presented extensive hydromyelia difficult to classify.

*Removal of the block* is obviously impossible in the average infantile hydrocephalus. The first block may not be the last. If an aqueduct is closed the subarachnoid space may be closed

the most satisfactory. But dyes are on the whole very misleading, for small traces may appear on the other side of a complete functional block. Also the rate of absorption of dye from a cavity is not an infallible index of fluid absorption from that cavity since it may escape with some fluid through the needle tract, to be absorbed in the superficial tissues.

The use of air, or better oxygen, makes localization of the block easy and indicates the extent of the dilatation, but unless the procedure is followed shortly by effective therapy it may result in death because of the further rise in pressure which follows in the first days after ventriculography. Repeated ventricular puncture has the same eventual augmenting effect upon the pressure.

*Intraventricular pressure* is raised initially by obstruction to the third circulation. This rise of pressure has certain important effects upon the intracranial circulation of blood. Arterial blood enters the large arteries at a pressure that we may call 1,300 millimeters of water. It leaves the cranial chamber normally in the dural sinuses at a pressure of 100 millimeters or less. The large veins on the surface of the brain carry blood which must be at a pressure slightly above that figure and a little above the pressure of the cerebrospinal fluid which is normally 150 millimeters.

In internal hydrocephalus the intracranial pressure varies between 300 and 500 millimeters of water. The pressure within the large cerebral veins must rise correspondingly or the thin walls of these vessels would be obliterated. Chronic hydrocephalus does not cause the systemic arterial pressure to rise, but the blood stream within the arterioles and venules of the choroid plexus must be under a much increased pressure in order to maintain a flow outward to the sinuses through the great vein of Galen, for example. This vein would of necessity collapse unless its intracranial pressure equaled that of the cerebrospinal fluid.

It seems probable that this increased arterial pressure within the choroid plexus and the enlargement of local capillaries which must accompany it within the choroid plexus, must produce an increased outpouring of cerebrospinal fluid even against the raised pressure

also and it is probably impossible to open it. This explains the failure even in the hands of the most expert surgeons, of heroic attempts to carve out new pathways. A true obstruction of the foramina of Luschka and Magendie should be removed surgically, but this is a very rare condition in our experience (1 case in 44). Simple dissection of the posterior fossa which is so effective in adult adhesive arachnitis does not suffice in infants.

"Short circuiting" of the cerebrospinal circulation is occasionally effective, this means making an opening from some ventricular space directly through into the subarachnoid spaces. Corpus callosum puncture has in a few rare instances on record resulted in cure. Subtemporal and subfrontal exposure of the basal cisternæ and incision through them into the third ventricle has been carried out by Dandy and by Naffziger. This may well prove to be the best site for "short-circuiting."

Removal of choroid plexus has long been carried out by occasional optimistic surgeons and all surgeons who continue to face the hydrocephalus problem require the support of fortified optimism. The choroid plexus is not the seat of the pathological cause and for that reason the procedure of removing it has been likened to the removal of the kidneys for stricture of the urethra. Nevertheless, there are not a few cases in which some capacity for fluid absorption is preserved. The procedure in such cases seems rational. The best method is no doubt the cautery devised by Dr Tracy Putnam which has reduced the operative shock to a minimum.

Postural dehydration is a method of treatment invaluable for mild cases. Those cases of infantile hydrocephalus in which there is a close balance of absorptive capacity and fluid formation, gradually develop a greater absorptive capacity if they can be carried on over the first year and the balance is tipped in favor of absorption by this method.

The child should be kept continuously with the head above the sacrum. The head of the crib should be kept up as high as possible and the patient should be carried in a perpendicular position always. This reduces the pressure in the emerging cranial veins to a minimum, thus promoting absorption and decreasing

intracranial pressure. Further, the diet should be concentrated as much as possible. Even small infants should be placed on a high percentage of solid food such as gruels with no water added. Success demands careful pediatric help and supervision. The concentrated diet usually makes the infant constipated.

For 10 years I have used this treatment for less severe cases of hydrocephalus and I have seen many (perhaps 10 or 12) permanent cures, particularly in cases associated with spina bida. Fay has found dehydration helpful in this condition as in numerous others.

In conclusion, the treatment of hydrocephalus demands separation of the cases of external fluid collection from internal hydrocephalus. In internal hydrocephalus there must be a careful analysis of the nature and site of the block. If the block is not removable by medical or surgical means, "short-circuiting" procedures provide a hope of success in those few cases in which the subarachnoid space remains open. Removal of the choroid plexus by simpler procedures may also have a future. But for milder cases, and as an added help to other methods of attack, postural dehydration will be found to be of great value.

Confession is good for the professional soul. I must therefore confess that after the cases of removable block are eliminated, after external hydrocephalus is eliminated and after the mild cases of internal hydrocephalus are set aside, I face the remaining hydrocephalic infants with an uncomfortable premonition of failure, a premonition which I am sure is not shared by those surgeons chosen to discuss this paper. Dr. Mixer and Dr. Putnam.

#### SPINA BIFIDA

In regard to spina bida, well directed therapy may be much more effective. Three years ago my associate, Dr. William Cone, and I presented a study of 33 cases of spina bida and cranium bifidum and we described an operative procedure which adequately closes the defect and at the same time preserves the meningocele sac, thus avoiding the danger of hydrocephalus as a sequel to operation. (6)

Subsequent experience has amply justified our hopes for the procedure. In spina bida there is a defect in the vertebral arches usually

known fact that hydrocephalus may be produced by surgical amputation of this sac

Dorothy Russell has recently pointed out that spina bifida with meningocele is associated with an elongation of the bulb and cerebellum downward into the cervical canal so that the cervical roots run in a cephalad direction to their foramina of exit. She urges that this abnormality—the Arnold-Chiari malformation—allows the spinal fluid to pass from the fourth ventricle downward into the spinal canal, but blocks its passage forward into the basilar cisterns so that the meningocele sac replaces the cerebral subarachnoid spaces so far as absorption of fluid is concerned

#### PLASTIC REPAIR

From this demonstration it follows at once that the proper surgical procedure for treatment of spina bifida should include preservation of this fluid-absorbing tissue, which may take the form of a sac or of a sponge

The protrusion is covered by a continuation of the skin which may be no thicker than a membrane, a circular incision should be made so as to preserve as much good skin as possible for closure. The skin and membrane which cap the protrusion are then peeled off by careful sharp dissection. The sac is opened, evacuated of fluid, sutured again, and rolled up in a little heap and covered by a protective layer of fascia. The fascia for this closure can usually be obtained by reflecting the covering of the muscles of the back toward the spinal defect, leaving the attachments of the fascial flaps at the margin of the defect

The skin is then drawn together, great care being taken to put all strain upon a suture layer in the superficial fascia and not on the skin itself. The danger of infection and of hematoma formation in the dead space beneath the skin is an ever present one. Careful handling of tissue, closure with fine interrupted silk sutures, application of waterproof protective dressing, and immobilization of the infant in a prone position are among the procedures which contribute to successful healing. What has been said above in regard to spina bifida applies equally to the suboccipital region. The defect is usually in the suboccipital region with maldevelopment of the cerebellum be-

posterior, occasionally anterior. In cranium bifidum the same is true. If the defect is covered with skin the spina bifida is called occulta. If, in place of skin, a meningeal sac presents without nervous tissue in it, the spina bifida is said to be associated with meningocele. If the sac contains roots or attached spinal cord, the spina bifida is said to be associated with myelomeningocele. If no sac is formed at all and maldeveloped nervous tissue presents itself, the condition is termed rachischisis or vertebral splitting. Cases of rachischisis are not to be operated upon

Spina bifida occulta calls for operation only when associated with advancing paralysis during the growth period. Up to the third month of intra uterine life spinal cord and spinal canal are equal in length. From then on the canal lengthens more rapidly than does the cord. As the brain cannot be displaced from its proper cavity the cord migrates upward, or to be more accurate, the canal grows downward away from the cord, while the spinal roots elongate and the cord itself terminates at the first lumbar spine instead of the last sacral. In all forms of spina bifida the cord or roots are apt to be attached locally to the protrusion. Hence at any time during growth of the patient's body spinal symptoms may develop, due to an increasing downward traction. This most often manifests itself as progressive incontinence of urine, or progressively increasing weakness in the feet. The only treatment is, of course, operation to free an attached cord or spinal roots

Spina bifida with meningocele or myelomeningocele presents a sac—an evaginated diaphragm. This sac is ballooned out over the defect by cerebrospinal fluid. The sac tissue is made up of gelatinoid material which weeps spinal fluid on section. Histologically, fluid spaces are seen within it. Blood sinuses and arachnoid cell tufts are encountered, identical in structure and arrangement to the pachyonian bodies and dural sinuses of the cranial cavity. Consequently the tissue of the sac resembles the absorbing tissue of the cerebral arachnoid. This sac is an absorbing mechanism for spinal fluid, as we have shown by injection of intravital dyes during life. I further point out that this is the case, is the well

neath the defect, yet the children seem to grow up quite well except for an ataxic gait.

Well over half of the total cases of spina bifida and cranium bifidum are suitable subjects for operation with a mortality no greater than 10 per cent. Contra indications to operation are gross paralysis pre-existent hydrocephalus, or the absence of sac, as in rachischisis. An ulcerated or ruptured sac should be operated upon within 24 hours of birth if possible. Otherwise 3 to 4 weeks of age is the time of election.

After operation the tendency to hydrocephalus which many of these infants will show must be combated by postural treatment and by energetic dehydration. This aids cerebrospinal fluid absorption as it does in any case of mild hydrocephalus, but further, erect posture raises the pressure of cerebrospinal fluid at the level of the meningocele sac thus increasing the rate of absorption in that organ.

Such an article as this could hardly do justice to pathological anatomy. But practical therapeutics must be the primary interest of all surgeons worthy of the name. Many

infants with spina bifida are being allowed to die each year—infants who might have grown up to be normal men and women if the available surgeon had understood the principles involved in treatment. And nothing in surgery is so satisfying as the knowledge that one has saved a life when others had abandoned hope for the poor derelict.

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#### Discussion

DR WILLIAM J. MIXTER Boston. Dr Penfield has stated that confession is good for the soul; that notwithstanding his investigations he faces many cases of hydrocephalus with a premonition of failure but thinks Dr Putnam and I should not do so. I don't see why he says that I should have less of this feeling than he. In the earlier days of neurosurgery our results were far less favorable than at present and hydrocephalus has always been a neurosurgical bugbear.

I agree that the usual classification of communicating and noncommunicating hydrocephalus is of little value. It is important however for us to know the position of the most distal block. If it be in the aqueduct or the roof of the fourth ventricle a determined attempt to remove the block or form a false passage is in order. Some of our most spectacular cases are in this group but unfortunately the group is small. The use of dyes and ventriculography as Dr Penfield has stated is uncertain and sometimes dangerous yet these measures do help us somewhat particularly the latter. What we really need is a test that will conclusively demonstrate block between the basal cisternæ and the cerebral subarachnoid space or a fault in the absorptive mechanisms. If the block is in either of these locations (and it frequently is) all operative procedures directed toward removal of block from the aqueduct or fourth ventricle or attempts to form a new stoma

between the third ventricle and the interpeduncular cistern will be doomed to failure. Several years ago I attempted this procedure with the use of a cystoscope and though I could puncture the floor of the third ventricle the operation was not a success.

I feel as Dr Penfield does that exposure of the basal cisternæ and incision of the third ventricle is hazardous and unsatisfactory, nevertheless, a short circuiting operation of this sort may be considered in selected cases when the time comes that we can definitely locate the position of the block.

I have felt that operative removal of the choroid plexus was too hazardous an operation to be of great value, but I have watched Dr Putnam develop his technique with great interest and believe that it is by far the most satisfactory particularly where some portion of the absorptive mechanism is still active.

Dr Penfield has described postural dehydration and restriction of fluid intake. These I believe to be of great importance in the mild case and a useful adjunct to operative interference in the severe one.

In his discussion of spina bifida Dr Penfield states that spina bifida occulta should be operated on only during the period of growth and if neurological signs are increasing. I should be a little more enthusiastic than that. Certain cases of spina bifida occulta have associated congenital neoplasms of the cauda equina which are removable and can be demonstrated only by operation, while others will show an increase in

the 5 other cases, only 1 was from postoperative death occurred within 48 hours after operation. Two patients died of respiratory infection, 1 of diarrhoea, 2 patients died at home after discharge from the hospital.

Though laying myself open to the charge of optimism, I cannot help feeling that these statistics could easily be much improved. Up to the present, our policy has been to operate upon every case, no matter how desperate, in order to see how much could be accomplished and what the dangers of secondary damage might be. Some of the patients have been almost moribund at time of operation, others have been almost certainly doomed, as for example, the child with the leaking meningocele. We do know a little better what can be accomplished and our necropsies have shown that damage to brain tissue is slight. While it appears quite unjustifiable to pay too great attention to one's operative statistics in a disease which carries such a high mortality as hydrocephalus, we are now beginning to refuse the hopeless risks. Doubtless as a result, I have had only 1 death among the last 6 patients operated upon.

It seems to me not wholly appropriate to compare the choroid to the kidney. I doubt whether any series of bilateral nephrectomies would show a fatality as low as 50 per cent, even if a few stray bits of tissue were left behind. Perhaps an apter analogy would be the removal of the gall bladder for obstruction of the cystic duct.

I have sometimes considered in regard to certain of the cases reported here, whether I should not do catheterize the aqueduct or loosen tensor fossa and catheterize the aqueduct or loosen adhesions. I have never brought myself to do either, feeling that ventriculostomy alone is a more conservative procedure. The situation would, of course, be different in a child in whom the possibility of tumor or "arachnoiditis" had to be considered.

While my own experience with spina bida is small, I should like to comment briefly on Dr Penfield's remarks on this subject also. I think we can all agree that the best results are to be obtained in cases in which it is possible to do a closure in layers as he recommends. I personally should not feel justified in restricting myself to such cases, for while the mortality of operations on sessile sacs and on patients with perarys is high, occasional good results are obtained as a small reward for much labor expended. Further, we are less disturbed by the possibility of development of hydrocephalus than formerly.

The subject of the surgery of hydrocephalus is by no means closed, and all of us who are faced with the problem are looking forward to hearing Dr Penfield's full report of his survey of the splendid collection of pathological material in his possession.

Dr Tracy J. Fernald, Boston I am pleased that Dr Penfield emphasized the fact that cortical atrophy occurs relatively slowly as a result of increased pressure alone—perhaps no more rapidly than in adults with increased intracranial pressure. It is my impression also, from both clinical experience and autopsies, that many of the infants who remain undischarged following relief from hydrocephalus were those who suffered in the first place from a primary cortical aplasia.

I shall continue my discussion largely to the subject of hydrocephalus, since it is in respect to this condition that we have experienced the new awakening of hope to which Dr Penfield has referred. Our experience with congenital hydrocephalus has been better than his, but I should judge happier. Perhaps I may best define my own experiences with undischarged cases of the choroid by giving some brief statistics. The operation has been performed 18 times in 16 patients. In all of these patients the intracranial pressure has been decreased. Seven of them are alive and have shown no enlargement of the head or bulging of the fontanelle for periods of weeks to months. Of these patients, 1 developed a diplegia, apparently the result of its fourth operation. An eighth child is alive, and its intracranial pressure has been somewhat relieved, but further operations are not planned on account of the patient's general condition.

Turning to the other side of the ledger, there are 8 deaths to report. Autopsy has been performed in 3 of these. The reported causes of death have been infected meningocele, with microgyria, bronchopneumonia, microgyria, and absence of the corpus callosum, bronchopneumonia with microgyria. Of

possible

THE DIAGNOSIS AND TREATMENT OF DIVERTICULITIS AND DIVERTICULOSIS<sup>1</sup>

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**D**IVERTICULA are noted at all points in the intestinal tract from the pharyngo-oesophageal junction to and including the rectum. While accurate anatomical descriptions, chiefly from postmortem studies, were given by various authors—notably Virchow, Graser, and Fischer—during the latter part of the last century, the appreciation of their surgical significance came with the beginning of the present century, the attention of the profession being directed to it by the papers of Beer, W. J. Mayo, Moynihan, Drummond, Mummery, and others.

In the last 25 years the literature upon the subject has become quite voluminous based upon clinical and pathological studies of a sufficiently large number of cases to warrant accurate interpretation of pathology, diagnosis and treatment. The fact that in their symptomatology they offer a counterpart of other diseases common to the intestinal tract at the points at which they occur lends an added interest to their study. They occur as sacculations projecting from varying portions of the circumference of the intestinal tube—mesenteric, antemesenteric and lateral. They may range in number from one to several hundred, Hausman reports one instance in which 400 were found. They are usually single in the oesophagus, single or comparatively few in the duodenum and jejunum, chiefly of the Meckel's type in the ileum and they reach their greatest profusion in the colon, particularly in its left half. Diverticula have been described as congenital or true, and acquired or false—the former containing all the coats of the intestinal tube, the latter representing protrusions or herniations of the mucous and submucous coats through apertures in the muscularis. The term diverticulosis connotes the presence of such sacculations while diverticulitis implies the varying changes which occur as the result of irritation and inflammation. Pulsion diverticula of the pharyngo-oesophageal junction are observed usually at

the level of the lower border of the cricoid cartilage. They occur most frequently in men and commonly as one approaches or passes middle age, representing a protrusion of the mucous membrane between the muscle fibers forming the posterior wall of the pharynx. The longitudinal muscle fibers diverge at this point to their insertion in the cricoid cartilage, the gap created by this divergence is filled in with the transverse and oblique fibers of the inferior constrictor, forming a thin muscular coat weaker than the remaining portion of the pharyngo-oesophageal tube. As a result of pressure from within, separation of the muscle fibers occurs coincident with a protrusion of the mucosal coat. Always small in the beginning they may attain almost incredible size, one in our series showed a capacity of one pint and extended into the chest as low as the third rib. The entrance to the sac is always on the posterior wall but the sac itself as it develops pursues a downward course along the oesophagus, far more frequently on the left than on the right side—exceptionally long ones reaching at times well into the thorax.

During the early stage of development the symptoms are obscure. The decomposition of retained food particles gives rise to irritation in the sac and at times in the larynx, causing cough and the expectoration of a tenacious mucus. Difficulty in swallowing is occasioned by the filling of the sac, the food being regurgitated into the mouth either because it cannot pass the distended sac or else because muscular contraction forces up the food which has lodged in it. Not infrequently the patient repeatedly empties the distended sac by pressure with the hand, the process of getting down a satisfying quantity of food being a protracted one. Sooner or later the nutrition suffers and there is both loss of weight and strength, with more or less marked dehydration. With fairly large sacs which have not yet found their way into the thorax a visible swelling appears in the neck when they be

<sup>1</sup>Presented before the Clinical Congress of the American College of Surgeons, October 25-29, 1934.

come filled with food. In addition to the dysphagia, large sacs may occasion heartburn by pressure on the recurrent laryngeal nerve and dyspnea by pressure on the trachea. The development of the sac is essentially a slow one. The history of increasing difficulty of swallowing over a long period of time, with the regurgitation of food showing no evidence of gastric digestion, strongly suggests the presence of a swelling in the neck following attempts at swallowing food makes the diagnosis fairly certain. Fluoroscopic examination, employing both anteroposterior and lateral views during which the patient attempts to swallow a barium-acacia meal, will give full information as to the location, size, and shape of sac.

Curative treatment consists in extirpation. In patients debilitated by starvation and dehydration it is essential that adequate preparatory treatment be carried out before operation is undertaken. This consists in the administration of food and fluids by means of the Levine tube or catheter if either can be passed beyond the mouth of the sac, otherwise glucose and fluids introduced intravenously and subcutaneously. In an extreme case in which there had been a weight loss of more than 100 pounds and in which all efforts to enter the esophagus, including direct vision with the esophagoscope, had failed, we resorted to gastrostomy as a means of giving nourishment over a sufficiently long period to enhance the safety of extirpation. When the sac has reached the thorax we prefer the two-stage operation advocated by C. H. Mayo, by which procedure infectious mediastinitis can usually be avoided. The one-stage operation is satisfactory for the smaller sacs. Various methods of dealing with the neck of the sac have been suggested. We have endeavored to close them down to the site of closure to take care of leakage should it occur. Postoperative feeding for the first 4 days is given through a tube introduced through the nose or mouth to a point below the site of operation, after which time fluids and semi-liquid foods are given until the wound heals. Deep seated diverticula of the esophagus are much rarer than those at the upper end, are usually of the

traction type, and rarely occasion symptoms unless associated with cardiospasm. In the latter event dilatation of the cardia will usually bring about relief of symptoms. Diverticulosis of the small intestine, first described by Chomel in 1710, has, with the exception of Meckel's diverticulum, received no surgical consideration until within the present century, most of the records having appeared in the past decade. Diverticula are not infrequent in the duodenum, being found in all 3 of its divisions. They are less frequently observed in the upper portion of the jejunum and with the exception of the diverticulum of Meckel are seen but rarely in the ileum. In the majority of the reported cases the opening into the sac has been situated on the mesenteric side while both lateral and antemesenteric openings have been described. Both the congenital, or true, and the acquired, or false, types are found in the small intestine and are observed at all ages, the latter being most frequent at and after middle age. The former have been found in infants at birth and are usually single, they have been found with pancreatic tissue at their apices, while their most frequent location in the duodenum is near the papilla of Vater, where the pancreatic ducts are developed from duodenal buds. The acquired ones develop and produce symptoms late in life when atrophy of the musculature, particularly the circular coat, may be a predisposing factor, they occur most frequently on the mesenteric side of the bowel where the vessels penetrate the muscularis. They vary in depth from  $\frac{1}{8}$  inch to 2 inches or more. The fluidity of the contents of the small intestine is such that solid material is rarely found within these sacs although the stomata which connect the diverticula with the intestine are smaller than the cavities of the diverticula. Chomel in 1710, Harley in 1875, and Cole and Roberts in 1920 have reported diverticula of the duodenum containing gall stones, while Terry and Muegler and C. M. Watson report instances of intestinal obstruction due to the formation of enteroliths in diverticula of the jejunum. Morrison and Feldman report a primary carcinoma in a duodenal diverticulum. Diverticulosis of the small intestine may exist throughout life without giving rise to

symptoms, being found only at autopsy. With the retention of decomposing food leading to distention, irritation, and inflammation of the sac or its surrounding structures, symptoms arise. None of these are pathognomonic and a diagnosis cannot be made on clinical evidence alone. Diverticula are not infrequently associated with ulcer, cholecystitis and pancreatitis and when so the symptoms caused by the latter will predominate or else becloud the picture. Upper abdominal discomfort varying from a slight ache to severe colicky pain is one of the commonest symptoms. The pain may be relieved by food or alkali or may recur after eating and there are frequently long periods of freedom. Sour stomach, belching, and nausea are at times noted. The symptoms are so indefinite and so variable, simulating those of lesions of adjacent organs, that clinical deduction alone will not permit a diagnosis. The condition may however, be demonstrated with a high degree of accuracy with the X ray. The information which such an examination affords gives one an important lead in evaluating the significance of the presence of diverticula. Those which are discovered accidentally during routine X ray examination of the gastro intestinal tract and which are not causing symptoms require no treatment. Those in which inflammatory changes are present may require excision. The observation of retention of barium in a diverticulum for a much longer time than is required for the emptying of the stomach, associated with tenderness on point pressure, when other upper abdominal lesions are ruled out, may be considered as indicating diverticulitis. In the event of associated ulcer, cholecystitis, or pancreatitis it becomes a matter of judgment to appraise correctly the role played by each and to determine for or against excision of the diverticulum in addition to selecting the appropriate treatment of the associated lesion. In case of doubt or in debilitated patients in whom the excision would materially enhance the operative risk, the latter procedure may be omitted until such time as the indication for it becomes more apparent.

For patients in whom the employment of surgery is contra indicated and for those in whom symptoms are not sufficiently definite

to warrant operation, a medical treatment based on that for duodenal ulcer is most likely to give good results. When the roentgenological examination has shown the presence of spasm of the pylorus or duodenum the additional employment of belladonna will be helpful. Constipation which is a frequent accompaniment, should be relieved by appropriate measures.

The complications of diverticulosis of the small intestine which demand surgery for relief are diverticulitis, suppurative peridiverticulitis, perforation, and intestinal obstruction. The important anatomical points to be borne in mind are the relation of the peritoneum to the sac, the relation of the sac to the vascular supply of the intestine, and the relation of the sac to adjacent structures. The latter point is particularly applicable to duodenal diverticula which may be in close relation to the common duct in front of the pancreas, behind the pancreas, or buried in its head. The surgical procedure employed must be suited to the pathological condition found, invagination or excision of the sac with closure of the defect in the intestinal wall fortifying the latter where possible with an omental fat graft, drainage of abscesses with or without excision of sac, resection of intestine or pylorus gastro enterostomy—all find a place in dealing with the various pathological pictures presented.

The most commonly observed diverticulum of the ileum is the persistent intra abdominal portion of the vitelline duct, this type was first accurately described by Johann Friedrich Meckel and given his name in 1812. The vitelline or omphalomesenteric duct connects the yolk sac with the midgut and normally becomes obliterated in the seventh or eighth week of fetal life, the atrophy beginning at the distal end and progressing until the lumen of the ileum is reached. The artery and veins which accompany this duct normally disappear entirely with the exception of that portion which becomes the superior mesenteric artery and vein. Complete failure or obliteration will leave a tube communicating with the ileum at one end and with the umbilicus at the other from the latter of which feces are discharged. Obliteration at both ends will



palpable mass in the right lower quadrant. A diagnosis of intestinal obstruction due to intussusception was made from the history and physical findings. Autopsy showed an invaginated diverticulum with the ileum telescoped into the ascending colon.

Inflammation of Meckel's diverticulum simulates very closely that observed in the appendix, both as regards the symptoms and the sequence of pathological events dependent upon it, for it causes diverticulitis, peridiverticulitis, abscess and perforative peritonitis. The symptoms of obstruction produced by the various lesions of Meckel's diverticulum, as well as those of the inflammatory phenomena induced by it, do not in any wise differ from those arising from other causes. The history of a persistent umbilical fistula or the finding beyond the age of infancy are suggestive, so also are right-sided appendiceal symptoms in the known absence of the appendix. X-ray studies have been of little value in the recognition of Meckel's diverticulum. No one symptom or combination of symptoms, aside from the presence of a congenital umbilical fistula, can lead to any high percentage of correct diagnoses.

The important lessons to be learned from the literature on Meckel's diverticulum are that its complications possess an inherently high mortality and that prompt diagnosis, at least, of an abdominal emergency, with consequent early operation is important. The procedures employed must needs suit the individual case and consist in enterostomy, release of obstructive bands and intussusception, ablation of diverticulum, resection of intestine and drainage, as indicated by the pathological findings. In view of the possible dangers from a Meckel's diverticulum, it should be removed when encountered in the course of operations for other lesions. My associate and I have seen symptomless diverticula in 31 instances, 30 in the abdomen and 1 in the sac of an inguinal hernia. Twenty-nine were removed, the 2 remaining possessed such wide openings and shallow depths as to render improbable the occurrence of complications. Scheetz (25) in 1923 pointed out that islands of gastric mucosa occur in the villous duct and proposed the theory of

leave a tube connected by a fibrous cord either to the umbilicus or the ileum or to both. Such a remnant may give rise to tumors of various types, cysts, carcinoma, sarcoma, and malignant myoma having been reported. Obliteration at the distal end leaves a tube of varying length connected with the ileum and communicating with its cavity. It may be found at any point of the small intestine below the duodenum, the usual location being from 10 to 30 inches above the ileocecal opening. Its usual attachment is antimesenteric and its length varies from a small protrusion to one (reported by Mill)  $3\frac{3}{5}$  inches long. Its distal end may be free or be attached by a fibrous band to the umbilicus, mesentery, or adjacent organ. In shape it may be spherical, conical, bulbous, or somewhat like the finger of a glove. Its walls consist of the normal coats of the ileum, possessing at times Lieberkuhn's follicles, Peyer's patches, gastric mucosa, and even accessory pancreatic tissue. Its incidence as estimated from autopsy statistics varies from 1 to 2 per cent. Surgical records have shown a varying incidence, as a rule somewhat lower than that derived from postmortem studies. This interesting vestigial remnant is responsible for a number of acute abdominal conditions which carry a potentially high mortality. It is a prolific cause of intestinal obstruction as a result of its attachment to the umbilicus or to some other portion of the parietal peritoneum, mesentery or intestine, resulting in constriction by band or kinking from traction. Volvulus of the diverticulum itself has been reported as well as sprangs. Obstruction may be produced by an intussusception, the intussusceptum having for its apex the invaginated diverticulum or the point of the ileum from which it arises. Hertzer and Gibson in 1913 reported such a case together with a careful study of 44 similar instances recorded in the literature. The average age was 13 years, with 49 per cent under 10 years of age. Of the 22 resections in the series, 13 died and 9 recovered, a mortality of nearly 60 per cent. Further reports are available in the literature, only recently we have observed this complication in a boy of 6 years, admitted to the hospital moribund with a

embryonal transplantation. Later he studied 30 specimens of Meckel's diverticulum by serial section. Of these only 17, or 57 per cent, were free of abdominal elements. Three, or 10 per cent, showed mucosa belonging to higher segments of the small gut, jejunum, and duodenum. Five or 16.6 per cent, presented islands of gastric mucosa, one contained pancreatic tissue and one pancreatic tissue and gastric mucosa. Muelengracht in 1918, Magrand and Durant in 1922, Crubal, and Hallopeau and Humbert in 1924 reported instances of peptic ulcer in Meckel's diverticulum showing both hæmorrhage and perforation.

Aschner and Karelitz in 1930 collected and studied 33 reported cases of peptic ulcer in Meckel's diverticulum and the ileum. The most common symptom was the passage of fresh blood and clots per rectum, it was absent in but 5 of the 33 cases, and in 1 of these anæmia was noted. The periods of bleeding varied from 1 of 36 hours causing death in an infant, to a man of 28 who had repeated hæmorrhages since childhood. Pain of some sort was noted in 21 cases, in many its onset being coincident with perforation. Sudden perforation was noted in 11, one third of the total number. A palpable mass was observed in 3, thus with the passage of blood suggested intussusception, but the stools lacked the usual admixture of mucus and the symptoms of obstruction were wanting. Gastrointestinal X-ray studies were made in 6 cases without giving helpful information. They suggest that unexplained cases of repeated intestinal hæmorrhages in which other lesions have been excluded be subjected to exploratory laparotomy, if peptic ulcer or Meckel's diverticulum be found the operation of choice is excision of the diverticulum with enterorrhaphy at right angles to the long axis of the intestine. Their summary is as follows: "Heterotopic gastric mucosa has been shown to occur at the umbilicus as a result of anomalous developmental structures arising from the omphalomesenteric duct. Such areas of mucosa have been demonstrated to produce a secretion containing free hydrochloric acid and pepsin with irritation, erosion and ulceration of the surrounding skin. The secretion could be excited by the ingestion of food or by local mechanical stimuli. Hetero-

topic gastric mucosa has also been demonstrated in Meckel's diverticula which have retained their connection with the lumen of the ileum. Chronic ulcers causing pain, hæmorrhage, and perforation, and histologically identical with peptic ulcer of the stomach, duodenum, and jejunum have been described in Meckel's diverticulum and the ileum in 33 cases. In 21 of these gastric mucosa was demonstrated in the diverticulum. The ulcers occurred in the intestinal type of mucosa adjoining the heterotopic gastric mucosa, being frequently located at the neck of the diverticulum which was usually completely lined by gastric mucosa."

The occurrence of diverticulosis is observed far more frequently in the colon than elsewhere in the intestinal tract. Autopsy records would indicate its frequency in 5 per cent of all subjects over 40 years of age. While the vast majority occur at and after middle life, they have been reported at much earlier ages. A. P. C. Ashhurst reporting a sigmoid diverticulitis in a child of 7 years and 9 months and Erdmann one in a child under 7 years of age. Only 20 in 1,819 patients at the Mayo Clinic showing diverticulosis of the colon were under 40 years of age. Diverticula of the sigmoid are by far the most common; the descending colon also being frequently involved. It is estimated that on an average 85 per cent are found in these two portions of the colon. The rectum, transverse and ascending colon share in the distribution of the remaining 15 per cent, with infrequent similar findings in the appendix. Our series shows 6 patients presenting diverticulosis of the appendix, in one of whom a diverticulitis with perforation had occurred. Stout (28) reports an incidence of 1.89 per cent, of diverticulosis of the appendix in the cases of appendicitis operated on at the Presbyterian Hospital, New York, in 1 year. The diverticula occur between the layers of the mesoappendix, projecting from the appendix like buds, and are frequently multiple. In addition to the danger of diverticulitis and perforation, the simple ones afford an added risk since in the process of cutting through the mesoappendix close to the appendix they may be opened, with resultant contamination of the operative field. While diverticula of the

as to the wisest course to pursue in the presence of an acute diverticulitis. Some prefer to pursue an expectant plan of treatment until complications arise which necessitate surgical intervention, i. e., perforation or abscess, while others, notably Erdman, advocate immediate operation, consisting of excision of the diverticulum with closure of the opening in the intestine or simple drainage as local conditions warrant. Since diverticula are so frequently multiple, the removal of one that presents acute inflammation affords no immunity to the remaining ones against similar changes. Erdman noted a 4 per cent record of repeated invasions in a series of 52 acute cases treated by operation.

Perforation into the peritoneal cavity produces a diffuse suppurative peritonitis not distinguishable from that produced by other infectious lesions and demands similar treatment. The peridiverticulitis, almost uniformly noted, makes this complication a rare one. Both in free perforations and in those resulting in localized abscess formation attempts at repair of the perforation are in order when local conditions permit. A certain proportion of these are successful, while the remainder, like those treated with drainage alone, result in fistulae. The latter are usually of small caliber and frequently heal spontaneously. When persistent, secondary closure or resection can be done later after subsidence of the acute reaction lessens the hazard. The subjective symptoms noted in chronic diverticulitis consist of periodic attacks of digestive disturbance with abdominal discomfort and uneasiness and at times definite pain which is usually referred to the site of the infected diverticula. Localized soreness and tenderness can usually be elicited in the region of the diverticula and not infrequently a mass can be felt. Roentgenological study constitutes the most important aid in diagnosis, not only locating the site of the lesion but determining as well the extent of the involvement. Many of the chronic cases prove self-limiting, presenting occasional periods of more or less activity with long intervals of quiescence. Such instances require no treatment other than supervision of diet with prevention of constipation. The oral administration of

colon may be single, they are as a rule multiple, varying in number within rather wide limits. Practically all of those observed in the colon are of the false or acquired type, the sac consisting of mucosa and submucosa covered with peritoneum. Regardless of the cause—upon which there is no unanimity of opinion—once the diverticulum is formed it becomes a bottle-shaped process, with a narrow mouth and wide body, into which the fecal current enters with the eventual formation of fecaloliths. There is consequent inflammatory change secondary to the obstruction and stagnation. There are no symptoms referable to simple diverticulosis. The percentage of such cases that ultimately develop diverticulitis and present subjective symptoms is controversial, but has been estimated at from 10 to 20 per cent. The symptoms are caused by inflammatory changes in the sac and surrounding structures, notably in the mesenteric, dependent upon inadequate drainage of the sac. The fecal current in the right half of the colon is largely liquid while that in the left half tends to become more and more solid, with the result that diverticula in the left half more frequently show the presence of fecaliths which obstruct drainage and predispose to the development of inflammatory changes. The symptoms of these necessarily depend upon their character and extent. With acute inflammation in a single diverticulum they closely resemble those of appendicitis—pain, nausea, and vomiting, localized tenderness and rigidity, and increased leukocyte count. If the diverticulum happens to be situated in the cecum or ascending colon differential diagnosis will be impossible until the abdomen is opened, and because of the mimicry of appendicitis such cases are almost routinely subjected to operation. When the lesion is in the left half of the colon a preoperative diagnosis can be more readily made. Granting the presence of a diverticulitis one of several results may follow, namely, resolution, perforation into a surrounding abscess, and thickening of the gut wall, mesocolic, and so that obstruction of varying degrees results. Opinion is divided

one of the petroleum preparations and the rectal use of oil or other soothing enemata will be of help. If spasticity is revealed by the X ray the addition of belladonna or stramonium to the above regimen will frequently suffice to relieve it.

The complications induced by chronic diverticulitis which demand surgical relief are fistulae and obstruction. The fistulae may communicate with the skin, adjacent intestine or bladder. The diagnosis of the former is self evident, the entero intestinal type will usually be revealed only at operation, while the enterovesical variety is evidenced by vesical irritability with the passage of feces and gas *per urethram*. The latter are easily demonstrated by cystoscopic examination. Operative correction of such fistulae may in some cases prove relatively easy, in others it entails difficult and hazardous procedures. The excision of the tract with closure of the opening in the bowel is the ideal. In our experience, this can as just stated be readily done in some instances, in others resection of the thickened, distorted bowel will be required. The enterovesical fistulae, if situated high up on both the bladder and sigmoid are accessible to manipulation and correction, if, however the opening is located low down in both organs the difficulty of access combined with the inflammatory infiltration make its correction both difficult and hazardous. In such cases we have elected to do a permanent colostomy with satisfying results. Obstruction may occur in acute diverticulitis as a result of infection and edema, when incomplete it not infrequently subsides under the expectant plan of treatment mentioned. When complete an enterostomy proximal to the lesion not only meets the immediate indication but often permits resolution of the diverticulitis to such an extent that no further surgery is needed. Chronic obstruction is due to hyperplasia, adhesions and angulation, the so called hyperplastic, stenosing type. Resection, where general conditions do not contra indicate its employment, is the treatment of choice. As with colonic resections for other lesions, experience has shown the two stage operation to be the safer procedure. Drainage of the bowel proximal to the obstruction allows recession

of the inflammatory phenomena at the site of the diverticulitis and the upbuilding of the patient's vitality, both of which enhance the safety of the second stage. The presence of blood in the stool is noted in a small percentage of patients with the obstructive type of diverticulitis. That it is not more frequently present is due to the fact that the pathological changes are so largely extramucosal, being found in the wall of the bowel, the mesocolic and surrounding fat. Jones quotes Spriggs as stating that bleeding occurred 3 times in 68 cases of diverticulitis, or 5 per cent, and Rankin as stating that it occurred 33 times in 227 cases, or 17 per cent. The presence of blood in the stool which can be demonstrated with the proctoscope to come from above the lower rectum has so great a diagnostic value for carcinoma of the colon as to make the differential diagnosis between carcinoma and diverticulitis at times extremely difficult when this symptom is present. The X ray may show one or more diverticula and the lesion causing the bleeding still be carcinoma. The history, the duration of symptoms, the character of defect as revealed by the X ray are all of value in reaching a decision.

A study of the recent literature indicates the incidence of carcinoma developing on diverticulitis at from 17 to 8 per cent. This incidence, together with the difficulty in distinguishing between carcinoma and diverticulitis in the presence of a palpable mass or defect revealed by the X ray, and associated with bleeding from above the lower rectum, makes early exploration a far safer procedure in all such cases than medical regimens which involve delay.

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# DISCUSSION

Dr DAVID CHEEVER, Boston Dr ABEIL, in his comprehensive paper, has summarized admirably the essential facts about abnormal pouches or diveritcula as they occur in the alimentary tract from the oral cavity to the anus. In many situations they are so uncommon as to be rarely encountered even by experienced surgeons, but the possibility of their presence should always be borne in mind, to explain symptoms or physical findings which are puzzling. Meckel's diveritculum, the congenital remnant of the omphaloenteric duct, is, however, a not uncommon cause of symptoms which are included in the barbaously ungrammatical phrase "acute surgical abdomen," meaning an acute symptom group related to the abdomen and demanding surgical intervention, whether or not the exact lesion can be diagnosed. It is only necessary for us surgeons to remember, if the obvious cause of symptoms is not revealed by exploration, that Meckel's diveritculum must be searched for and excluded as the possible seat of trouble. Moreover, as pointed out by Dr ABEIL, a peptic ulcer in a diveritculum lined by ectopic gastric mucosa is a well recognized cause of pain, bleeding, or perforation. Once a lesion of a Meckel's diveritculum is discovered, the course for the surgeon to pursue is usually self evident. The multiple acquired diveritcula of the colon, often largely confined to the sigmoid and descending colon, are said to occur in 5 per cent of persons 40 years of age and over and since they are always potential and often actual for acute or chronic infection, they merit the attention of every physiatrist, not as rarities but as frequent sources of serious conditions. From a state of complete innocuousness they range through symptoms of every grade of severity to conditions so grave that they delay the surgeon's skill. Dr ABEIL has spoken of simple diverticulitis, of slow perforation with adhesions and abscesses, of fistulous openings into the bladder, or other loops of the intestinal canal, of free perfora- tion with peritonitis, and finally of chronic inflammation with induration and fibrotic thickening which ultimately leads to obstruction. Such conditions as perforative peritonitis, abscess and fistula demand no special discussion of symptomatology or treatment, except to emphasize the great advantage of a preliminary colostomy in the proximal transverse colon, of permanent type, to divert the entire fecal current and permit the diseased segment to be put at rest and cleansed by through and through irrigation, thus favoring resolution and subsidence of the inflammatory process and permitting whatever more radical measures seem necessary to be done under favorable conditions. Especial interest attaches to the chronic obstructive forms of the disease. They may closely simulate carcinoma, or indeed be impossible to differentiate, and their successful treatment demands at least as much judgment and operative skill. The symptoms include varying degrees of discomfort, flatulence, pain referred especially to the lower left abdomen, constipation, obstipation, and obstructive leucocytosis may suggest an inflammatory rather than a neoplastic origin. Inasmuch as the lesion often involves a longer segment of the bowel than a carcinoma does, a mass is more likely to be palpable—often sensitive to the touch. A barium enema shows a lesion which narrows the lumen—often more extensive than carcinoma, the presence of one or usually multiple small diverticula in the neighborhood are suggestive but of course not pathognomonic, since carcinoma is as likely to affect the colon in the 5 per cent of individuals who have diverticulosis, as in an equal number of normal persons. In instances where the inflammatory lesion is not too extensive, a peculiar saw tooth or accordion-pleated serration of the barium shadow, due to deep and compressed folds of the mucosa, is quite characteristic. The finger examining by rectum can

not reach the lesion unless it is felt through the bowel wall as a pelvic mass, the proctoscope, if the process be low enough, reveals more or less occlusion with edema and thickening of the wall but no ulceration and no blood. The significance of the presence or absence of blood cannot be too strongly emphasized. bleeding is *not* a symptom of diverticulitis since the latter is not an ulcerative process, and if blood is noted as coming from a chronic obstructive lesion above the anal canal the overwhelming probability is that it is due to carcinoma. On the other hand while it is true that microscopic or chemical traces of blood are present in all cases of carcinoma, the small scirrhus contracting lesion often shows no gross bleeding. The association of carcinoma with diverticulosis or diverticulitis is in my opinion a pure coincidence.

The successful treatment of chronic obstructing diverticulitis of the sigmoid or descending colon may tax all the resources of the surgeon. A proximal transverse loop colostomy should be made to rest completely the diseased bowel and permit lavage. If under this plan the bowel is shown by barium enema to recover its normal contour and caliber and no complications occur it may be reasonable to risk closure of the colostomy and trust that a bland diet avoidance of constipation and colonic lavage will

prevent recrudescence of the inflammation. Such a happy event rarely occurs, however, and resection with restoration of continuity is indicated. The surgeon's personal experience and preference will determine whether this shall be done by suture or by the Mikulicz procedure; the latter is more applicable here than in carcinoma, since the tendency to skimpy resection is of less account and there can be no grafting of the disease into the wound. The frequent necessity of dealing with adhesions and complications, and the danger of spreading an already existing infection make these operations both difficult and hazardous and both patient and surgeon may have to be satisfied with, and thankful for, a permanent colostomy. A word must be added about patients with early stages or moderate degrees of diverticulitis. A bland diet mineral oil to keep the stools soft, and colonic lavage will cause resolution of the process and enable the patient to carry on, in the majority of cases, but both physician and patient should know that a potentially dangerous process is merely being kept under control and that a recrudescence should have the benefit of a surgeon's opinion.

In conclusion I wish to congratulate Dr. Abell on his interesting presentation of a very important subject—a presentation which bears the authority of very wide experience.

# THE REPAIR OF DEFECTS RESULTING FROM FULL THICKNESS LOSS OF SKIN FROM BURNS<sup>1</sup>

BROWN AND BLAIR REPAIR OF BURN DEFECTS

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If a burn destroys a large area of the full thickness of the skin, the result is an open wound. Unless there is early replacement of lost skin, healing will occur by contraction of adjacent tissues and by "scar" epithelium or permanent healing may never occur (Fig. 14). The restoration of surface losses and repair of contractures in patients appear complex in many instances, but from a study of the requirements of treatment in a fairly large group of patients, we have outlined the essential points of care that have usually proved of benefit for these patients.

*First* The general care is of primary importance and includes the exercise of patience and gentleness, and interest in the patient's welfare, by all who come in contact with him. The patient should be kept free from pain and from objectionable restraints, sedatives should be used carefully, and interest in surroundings should be developed, especially when the patients are children (Figs. 2D, 3C). Nutrition must be kept up, and transfusions may be required frequently.

*Second* The local care of the open wounds has for its object the cleaning up of the areas as quickly as possible so that the lost surface may be restored with skin grafts before damaging contractures have occurred. Surgical drainage is best accomplished by the use of saline dressings or by the continual saline bath for 3 to 4 hours a day followed by dry heat or further wet dressings (Figs. 1C and 3C). Many antiseptics (common and proprietary) and gentian violet have been used, but at present we rely on Dakin's solution if anything other than saline is thought necessary. The use of a firm pressure dressing that is kept moist by irrigation, combined with elevation, may be of great advantage for lesions of the extremities, marked improvement may be noted within 48 hours (Figs. 1, 3, and 10). Pain should be kept down to a minimum when the dressings are removed. They may be soaked off gradually in a bath, and it is important that some protector shall have been used next to the wound to prevent the granulations from growing up through the meshes. For this, old linen, perforated cellophane-like material, or very fine mesh gauze is usually satisfactory so that dressings can be removed even from children with a minimum of discomfort. When cellulitis is controlled, grease dressings (xeroform, zinc oxide, or scarlet red) on fine gauze or linen can be used, these allow the patient greater freedom, but they are not used for several days immediately preceding operation. Gentle mechanical cleansing of wounds daily is important, but care should be taken not to disturb epithelialization. Surgical drainage and pressure dressings usually result in wounds with bright red, firm granulations, free from surrounding cellulitis. Bacteriological studies have shown that it is probably easier to get sterile cultures from small wounds than from very large open areas. We have repeatedly grafted wounds when from the appearance of the granulations we have thought them to be ready, and we have had successful takes, with a minimum amount of cellulitis, when pre-operative cultures have shown multiple organisms. A thorough Carrel-Dakin technique is undoubtedly an advantage but it cannot replace careful evaluation of the general condition of the patient and of the gross appearance of the granulations and surrounding tissues. Another important result from the use of the saline bath for badly burned patients is that ordinary secondary contractures will have been straightened out by the voluntary effort of the patient without the use of traction or restraints. Most patients are extremely grateful for the bath and realize their first comfort in it, and we believe that it has occasionally been a life-saving measure. There may be a bad reaction to it, however, and there is frequently an elevation of temperature. If any of these

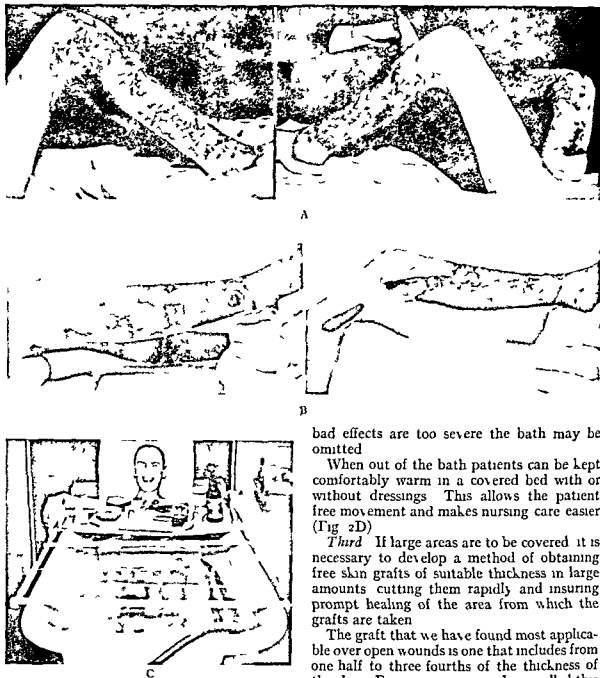


Fig 1. A Complete circular burns of both legs with a 90 degree flexion deformity of the knees several months after the burn. B Legs shown after a few weeks of daily saline baths. The granulations are clean, there is no surrounding cellulitis, the flexion deformity has been completely overcome and the legs are ready for operation. C, Patient in daily saline bath. General health much improved and he has completely overcome the flexion deformity by active movement without splints or traction of any kind.

bad effects are too severe the bath may be omitted.

When out of the bath patients can be kept comfortably warm in a covered bed with or without dressings. This allows the patient free movement and makes nursing care easier (Fig 2D).

*Third.* If large areas are to be covered it is necessary to develop a method of obtaining free skin grafts of suitable thickness in large amounts cutting them rapidly and insuring prompt healing of the area from which the grafts are taken.

The graft that we have found most applicable over open wounds is one that includes from one half to three fourths of the thickness of the skin. For convenience we have called this a thick split skin graft to differentiate it from a full thickness graft and from an Ollier Thiersch graft that usually includes little more than the epidermis. It might be called a thick Ollier Thiersch graft (Fig 4).

By using a sharp knife 18 centimeters long, very large grafts may be cut rapidly, and the





Fig. 1 D. Patient completely healed at time of discharge 3 weeks after the last of two operations. Note complete healing of donor sites of split grafts on back, buttocks, abdomen, and thighs.

larger they are the more easily they may be applied, grafts up to 18 by 5 inches may be obtained from suitable thighs. The suction retractor described in 1929 is used routinely, with it fairly large grafts may be cut even from the abdomen (Fig. 5).

These grafts are applied to the area after granulations have been carefully and smoothly shaved off or after any contractions have been fully opened by dissection, or scar tissue has been excised. They are held firmly in place with horsehair sutures all around and multiple mattressing sutures over the surface. Many stab holes are made through the graft to provide for drainage. It is important to note that the removal of granulations causes a good deal of bleeding and that over large areas it must be very carefully done, or even omitted if the patient cannot stand the added bleeding. It is a help in preserving blood to have an assistant hold compresses over an area as the following one is being denuded.

The donor areas require careful dressing with a fine mesh gauze impregnated with a thick ointment (xeroform, scarlet red, or zinc oxide) and held firmly in place. Healing is usually complete in 10 to 15 days, and we have

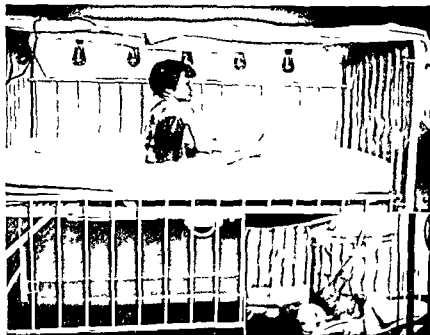
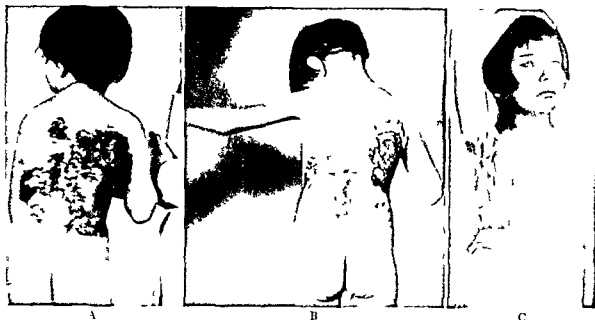
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*Fourth.* The care of the grafted area requires a simplified method of applying a pressure dressing and of keeping it moist if neces-

which is held in place with mattress sutures from gauze or sponge form being used over the graft rapidly and add but little time to the operation.

In some areas, mainly about the face, the split grafts are applied as "stent" grafts, either a wax or when dealing with split grafts, for they can be cut autografts that have been stored for several days, but this fact is not very important clinically, especially being investigated. It is possible to use successfully grafts stored in the patient's serum and in saline is taneous epithelization. The use of delayed homo- grafts are in place may actually be a turning point in his recovery and there may be an increased spon- grafts are in place may actually be a turning point in his recovery and there may be an increased spon- grafts are in place may actually be a turning point in his recovery and there may be an increased spon-

fresh homografts are used very rarely and only repairs. By using the split grafts wherever possible, the donor areas are preserved fairly well, and one is usually able to find skin enough to make acceptable repairs. At present autografts are used entirely for these the same donor area (Figs. 1, 3, 9, and 10).



D

Fig 2 A Wide pread body burn cleaned up in saline bath with healing to point shown in B in 6 weeks C Complete function and permanent bearing surface obtained in 2 operations by release of contracture and application of thick split grafts D Patient shown in a covered and heated bed without dressing and with out restraints or splints of any kind Active motion is encouraged and secondary contractures are limited and with early surface restoration function is usually complete The baby below is shown to illustrate a useless and dangerous method of fixation

sary If the wound has been originally quite dirty and refractory to treatment before operation or if there are any reasons to fear a degree of infection that might damage the graft a wet saline dressing with irrigation tubes incorporated in it is put on and pressure is obtained over the area with sea sponges bound

on firmly with heavy gauze rolls The dressings are kept constantly moist for 4 days at which time the first dressing is changed

If the area is quite free from contamination, a sponge pressure dressing is applied with a few layers of grease gauze over the graft (Figs 6 and 7)

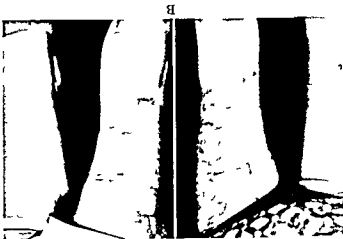
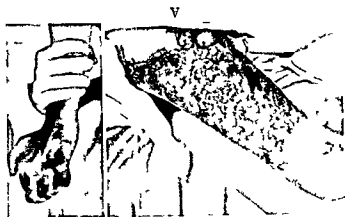


Fig. 3. A, Complete circular loss of skin of thigh and superficial burn of hand with secondary contractures and joint fixation. B, One month after discharge. There has been total and permanent restoration of the surface with thick split skin grafts with complete function in two areas. During the period of preparation, implantation of grafts, fresh homografts and delayed homografts were used in attempts to stimulate and delay healing. Note healing of donor areas on other leg. C, The saline bath in this instance was an invaluable aid in reclaiming the patient mentally and in preparing the wound for grafting. There has been much accomplished with occupational and physical therapy of the crippled left hand.

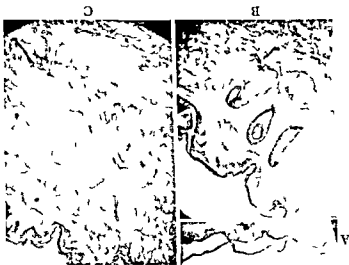
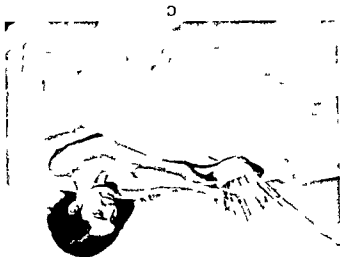


Fig. 4. Thickness of skin grafts. All three grafts cut from the same area from a single patient and photographed under the same magnification. A, Average Ollier Thiersch thickness. Most texts state that the skin is taken through the papillary layer, but even the thinnest ones usually include some derma. B, A thick split or thick Ollier Thiersch graft. The thickness shown here is greater than generally used. It can be roughly graduated between one third and three fourths of the full thickness. C, Full thickness graft, not quite all of which is gotten in the field of magnification.

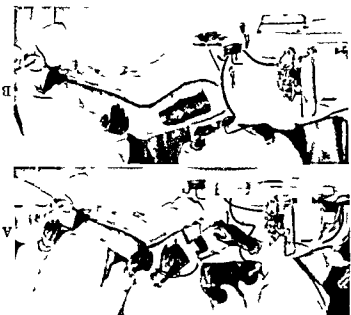


Fig. 5. A, Technique of cutting graft. The skin is lightly greased with vaseline, the knife is gotten very sharp and a good strong suction is supplied by the pump and delivered to the suction retractor through the tube. The assistant makes countertraction with the pump and delivered large as necessary or as the thigh will supply. B, Grafts as large as necessary or as the thigh will supply are taken. The graft is shown spread out on the table and should always be clamped immediately to the cover to prevent loss.

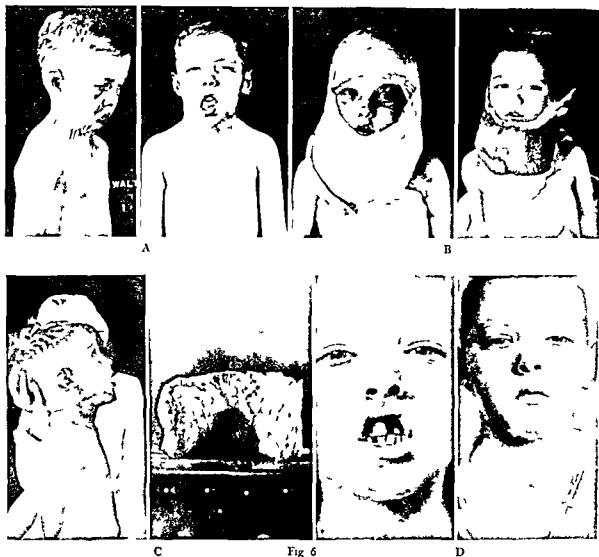


Fig 6 A Complete burn of neck with wide open bite of lower jaw resulting from traction on the jaw by scars B Sponge pressure dressing after first operation C The deformity has been released and the entire front of the neck covered with thick split grafts shown here at time of first dressing The sponges have made an accurate cast of the area D Final result with complete function and complete spontaneous correction of the open bite The contour and smoothness have been effected by putting in a wide full thickness graft directly across the front of the neck The helix of the right ear has also been restored

Fig 7 A, Growth of arm to side from wide skin loss over arm, chest, axilla and both axillary folds. B Fixation of dressing after application of thick split grafts A quilted bed pad is incorporated over the sponge pressure dressing and held with gauze rolls and adhesive C First dressing after operation showing the sea sponges as they have become molded in place D Complete release of the arm has been obtained and a full take of the thick split grafts is shown one operation Incision extends from anterior

superior spine over flank, chest, axilla and half way down arm. Although none of the scarred surface was removed, it can be seen that the only skin flaps available for closing were small ones over the flank The triangular insert of skin over the arm is to be noted as important in relaxation E Complete function apparent but close observation shows very tight heavy scar over hip that makes a general tightness and some hindrance to activity F The lack of sufficient skin surface has been corrected in one operation this has been accomplished by simply opening the scar and dissecting the edges back without sacrificing any surface and then covering the defect with thick split grafts as shown.

Fig 8 A Deep sinus in scar heavily contaminated Wide open bite of lower jaw B, Result of preliminary opening of sinus and complete release of the deformity C Result of application of split grafts in two operations Final restoration of contour and smoothness to be gotten with a full thickness graft across the front of the neck as in Figure 6

(Figs 7 and 8 on opposite page.)

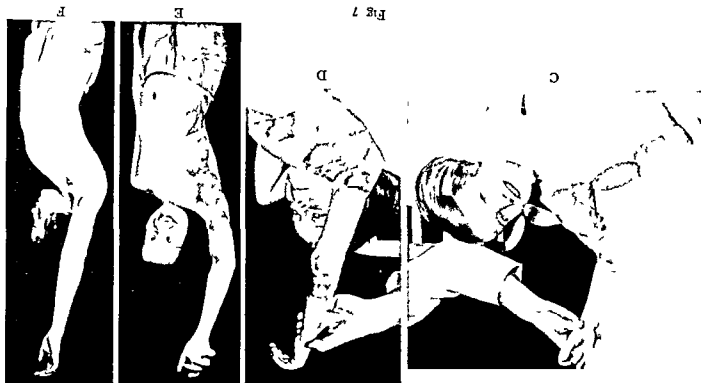
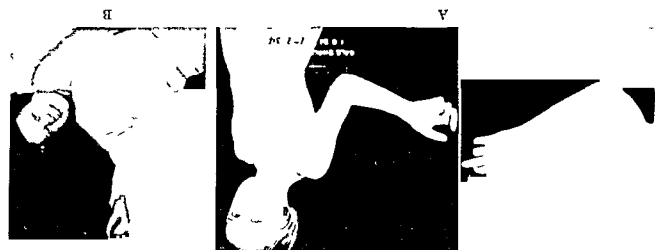


Fig 7



B

A

(Legends on opposite page)

Fig 8

C



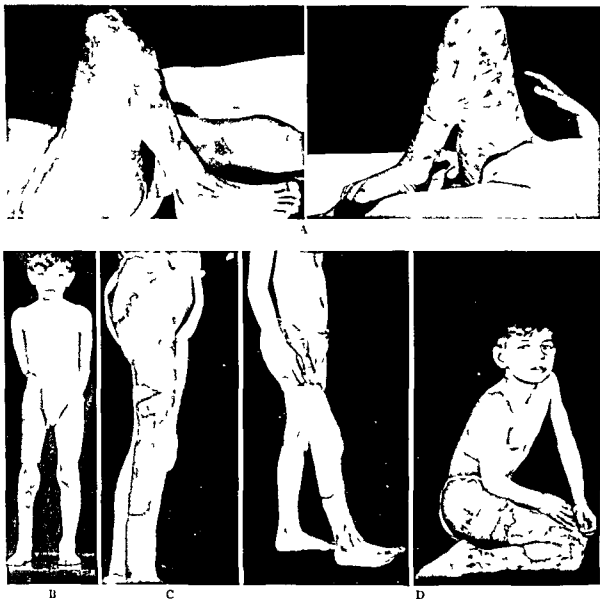


Fig. 9 A Complete fixation of leg to thigh one year after burn B Restoration complete and permanent after 6 months with thick split grafts The leg was opened at first operation to within 12 degrees of complete extension The remainder was accomplished by direct skeletal traction applied by Dr C H Crego The defect was then covered

with split grafts in two operations Note healing of donor areas on opposite thigh and abdomen C Note triangular insert of graft in thigh this is shown because of its importance in relaxation D This photograph which was taken 2 years later shows that there is complete function and no foot drop

Over many years' observation we have proved in our own minds the superiority of the sea sponge as a medium for obtaining pressure over skin grafts and have preferred to develop its use on a simplified plan rather than search further for substitutes That the pressure be applied and maintained is the

principle however, and if it is effected with a medium other than a sea sponge, the object has been accomplished

*Fifth* In the repair of late burn contractions, free skin grafts can be used extensively and give permanent bearing surfaces in many instances They often may be substituted for

a tedious, laborious use of pedicle flaps that require multiple operations

If there are sinuses extending down into scar folds, that harbor organisms detrimental to the chance of "take" of a skin graft, a preliminary opening is done, and sometimes a huge open wound is produced. In the grafting of all contaminated open wounds we use the thick split graft rather than a full thickness graft because of the greater assurance of its "take" in such a field (Fig. 8)

If the late contraction is healed so that a clean operation can be done, then the use of a full thickness graft can much more safely be undertaken, but even here, in many instances, the split graft can be used satisfactorily and may even be required if the area to be grafted is so large that the necessary amount of full-thickness skin cannot be sacrificed (Figs. 7 and 9)

One patient in the series has had 178 square inches of skin transferred at one time and 48 total or 1,381 square centimeters) In repairing healed contractures all surrounding skin possible is, of course, utilized. If there is dense scarring with marked contraction, it is seldom that flaps can be turned in from the surrounding area, the entire mo-

bilization being one of dissection and release of binding scars. In old cases in which the scar has been drawn out into a web and there is little or no deformity, it is occasionally possible to effect the repair by using the web itself. This is commonly called a "Z" or reversed "Z" plastic, however, the openings seldom actually resemble a "Z," and the main point to remember is that the two surfaces of



Fig. 10. Hand shown 2 weeks after a mangle burn and gentle debridement

B, Two days later after saline soaks, after a mangle burn



Fig. 10. Hand shown 2 weeks after a mangle burn and gentle debridement

B, Two days later after saline soaks, after a mangle burn

C, One month later after application of split graft. Patient able to work one week later. D, Four months later showing permanent bearing surface.

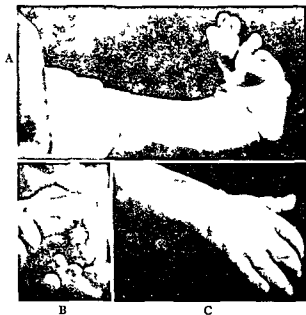


Fig 11

Fig 11 A Late deformity from wide skin loss. In most cases it is difficult to learn from the history whether or not the tendons have been lost. B and C Complete restoration in one operation with a full thickness graft, 1 month after operation.

Fig 12 A Deformity of neck and face from burn scar that extends from arm across axilla and that has pulled skin normally under the jaw clear down to the clavicle. B Correction of deformity with one full thickness graft let in low down. Surface unevenness left for later correction. C Completed correction with full thickness grafts done in two stages to avoid injury to lower branch of seventh nerve.

Fig 13 A Burn of scalp from beauty parlor combs. In this region scar epithelium is slow to form and usually gives an unsatisfactory bearing surface with marked tendency to repeated ulceration. B Restoration done in one operation with a single large split graft.

Fig 14 Failure of healing over 19 months period. There is a complete failure of spread of epithelium grossly and microscopically, but activity is evidenced by a marked piling up of dead cells. This patient was burned 19 months before had been in bed the entire time and had spent \$1200.00 on one single proprietary ointment recommended for the treatment of burns. He was treated as the patient in Figure 1 with restoration of the open areas on both legs in two operations.

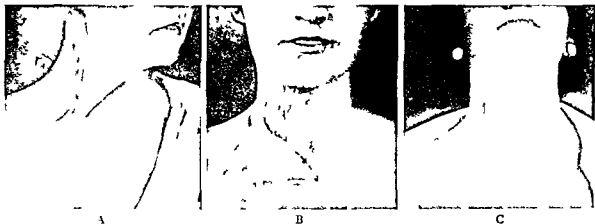


Fig 12



Fig 13



Fig 14.



sary. If there has been an extensive deep burn, as soon as sloughed tendons are separated and the granulations are clean, it is often advisable to "dress" the wound with a thick split graft so that healing may stimulate activity and joint fixation may be limited, then later any necessary thicker repair can be done (Figs 10 and 11).

*Scenilih* The rehabilitation of the patient's activities should be started early, if possible even before surgical restoration is started (Fig 3C). Children usually take care of this themselves but guidance in physical and occupational therapy is always beneficial. Burned hands may require special effort and the use of splints, as notably advocated by Kanavel, Koch, and Mason. In all the working contacts with patients, a firmness of purpose should be maintained that will tend to keep the patient's morale on the highest possible level.

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In some patients who have healing after very widespread burns, there may be no actual deformity but a general tightness of an area with perhaps some limitation of motion of an extremity. These patients frequently need surface tension is effected by simply opening across the tightest portion of the contracted area, allowing the edges to retract, and then filling in the open area with split grafts (Fig 7).

*Sixth* Burns of the hands deserve special attention because every effort should be put forth to prevent the deep infection that will so rapidly fix tendons and joints and produce deformities that may never be overcome. For deep losses, the first treatment should be active surgical drainage, active movement should be encouraged, the fingers should be dressed apart, and the whole hand kept in position of function. The average burn should be ready for grafting in 3 weeks, if tendons have not been exposed, and, frequently, the single application of a split graft may be all that is neces-

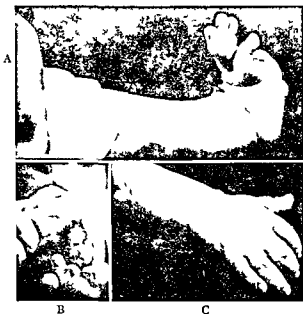


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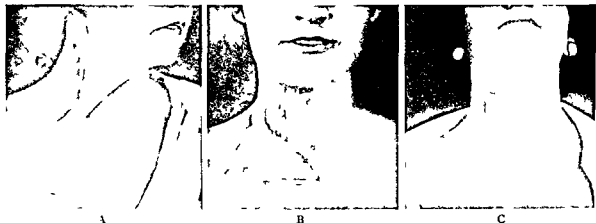


Fig 12



Fig 13



Fig 14.

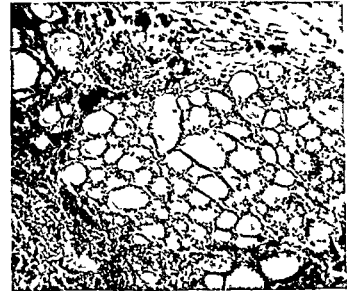


Fig 1 Thyroid cross graft in dog, 22 days old, low power



Fig 3 Thyroid cross graft in dog, 27 days old, low power



Fig 2 Thyroid cross graft in dog, 44 days old, low power



Fig 4 Thyroid cross graft in dog, 80 days old, high power

described briefly as follows. Under strict surgical asepsis throughout, tissue is removed from the donor, minced carefully into tiny fragments, 1 to 1.5 millimeters in diameter, and planted on a coagulated medium such as is used for tissue culture. After a day or two of observation to insure that the cultures are alive and not contaminated, they are transferred to new medium containing serum and plasma derived from the intended recipient of the graft. On this medium they are grown for a period of 2 to 4 weeks, being transferred to fresh medium as often as seems desirable. When ready for grafting, a small incision is made through the skin of the recipient, at the

avilla or groin, and a pocket pushed open by blunt dissection in the areolar tissue near the large blood vessels. The various fragments of graft are picked up on a pipette containing salt solution, squirted into the pocket, and the small incision sutured. If the grafts take, they grow slowly in size and after a number of weeks or months restore the physiology of the recipient to normal. This technique at present being used represents a development from many experiments in different directions, and on many aspects of the general problem, often resulting in failure, but leading on to better ways of attaining the object. It is, of course, subject to further improvement and

LIVING GRAFTS OF THYROID AND PARATHYROID GLANDS<sup>1</sup>

HARVEY B. STONE, M.D., I.A.C.S., JAMES C. OWINGS, M.D., AND GEORGE O. GILY, M.D., BALTIMORE

THE last few years have marked a great stride forward in the treatment of disorders due to deficiency in function of the glands of internal secretion. As a result of the discovery of active chemical substances derived from the glands—thyroxin, parathormone, cortin, etc.—the therapy of myxedema, tetany, and Addison's disease has been given a measure of accuracy and directness entirely new. These brilliant achievements of biological chemistry make it possible to supply from without the necessary substances that the body should produce for itself. The obvious next step in the conquest of these deficiency diseases is to restore to the body this power of producing its own needed substances, in other words, to graft into it a living, functioning gland to replace the one that has failed. It is the purpose of this paper to report in brief our work in this field, more extensive details having been published elsewhere.<sup>2</sup>

After several years of laboratory and clinical studies which began discouragingly enough but yielded increasingly promising results as time went on, we feel justified in saying with out reserve that we believe successful functioning grafts of thyroid and parathyroid tissue can be made from one dog to another and from one human being to another. As evidence of this we submit illustrations (Figs. 1 to 6) showing photomicrographs of tissue removed for study at intervals of 4 weeks to nearly ½ year after cross grafting. It is clear that this tissue is living, healthy and apparently functioning. In further evidence we submit the reports on a number of human cases in which there is reason to believe that cross-grafts have been successful.

**CASE 1.** Graft of human parathyroid tissue into patient with profound typical tetany following thyroidectomy 18 months previously, which was getting worse in spite of treatment. It is now over a year and a half since the graft was done. This patient is clinically well, has passed through normal labor successfully since the graft operation and has had a return to normal of her blood chemistry.

**CASE 2.** Graft of human parathyroid tissue into patient with spontaneous tetany, typical and severe. This case also has been completely successful clinically for a period of a year and a quarter, with return of the patient's blood chemistry to normal.

**CASE 3.** Graft of human parathyroid tissue into patient with postoperative tetany of severe grade. Duration of time since grafting about 5 months. Patient much better, blood chemistry approaching normal. Graft apparently successful and growing.

There have been 2 other grafts of parathyroid tissue, 1 for postoperative tetany and 1 for spontaneous tetany. In the latter case there was some doubt of the diagnosis. The patient was not benefited by the graft and it has not been repeated. In the first of these 2 cases a graft was apparently unsuccessful after 3 months, so that a second graft has been done. It is too soon to say whether this second graft, now about 6 weeks old, will succeed.

**CASE 4.** Graft of human thyroid tissue for myxedema after thyroidectomy. This patient has received grafts 3 times some weeks apart, as much more thyroid substance is required for health than in the case of parathyroid grafts. He has improved clinically, has lost 11 pounds in weight, can work and feel well on a fraction of the dose of thyroid extract formerly required, has a higher basal metabolic rate, and is regarded as a partial success. We hope that with the growth of the grafts in time this success may become complete.

We have also grafted thyroid tissue into several children and one adult for conditions of a complicated nature, part of which was apparently due to deficient thyroid secretion, but in none of these cases do we feel that we can claim success for the graft. It is perhaps unnecessary to point out that no type or method of grafting can reasonably be expected to yield 100 per cent successful results, but the evidence herewith submitted from both animal and human cases seems to us convincing that our method has proved that cross grafting of these two endocrine tissues can be and has been accomplished.

As to the method itself, the details of which have been published elsewhere, it may be

<sup>1</sup> Ann Surg 1934 59 Oct<sup>2</sup> Presented before the Clinical Congress of the American College of Surgeons, Boston, October 15-19, 1934.

It will be seen that experimental attack upon the problem of cross-grafting and analysis of the difficulties presented have led to the recognition and understanding of some of the conditions that are essential for success. No doubt further study will extend our knowledge and increase our mastery of this important field. The successful growth of mammalian tissue derived from one animal in the body of another, for an indefinite period of time and with preservation of physiological function is a matter of wide biological interest. Its practical implication in the field of medicine and therapeutics need only be suggested. Whether other endocrine tissues can be successfully transplanted by this or some similar method we cannot say. We do feel safe in saying that cross grafting of thyroid and parathyroid tissues has been accomplished, both experimentally and clinically.

the procedure  
 a part in the success of cross grafting. Young  
 tissue has a greater "growth potential"—a  
 term of unscentific vagueness but clear  
 enough meaning—than old tissue, and when  
 ever possible should be used as the source of  
 the graft. Also, the recipient is in better con-  
 dition to support and foster the graft if in  
 general good health than if suffering from a  
 variety of disorders in addition to the specific  
 tissue deficiency for which the graft is done.  
 Then there is the question as to whether a  
 graft can be expected to survive unless the  
 host has a physiological need for it. Halsted  
 suggested that such a deficiency was necessary  
 for the success of the graft and this idea has  
 been referred to as "Halsted's law of def-  
 ciency." It is perhaps unnecessary to state  
 that complete surgical cleanliness and avoid-  
 ance of infection is essential to the success of

STATISTICAL STUDY OF DISEASES OF THE ŒSOPHAGUS<sup>1</sup>

A S. MACMILLAN, M.D. BOSTON, MASSACHUSETTS

**I**N the past 10 years, 1,600 patients, or 1 of every 161 who have been admitted to the Out Patient Department of the Massachusetts General Hospital, have come because of dysphagia or some other symptom relative to the passage of food from the mouth to the stomach.

A study of these cases should give a reasonably accurate idea of the relative frequency of the various causes of difficulty in swallowing.

The entire series of cases was studied from the clinical, roentgenographic, and endoscopic standpoint.

No demonstrable lesion could be found in 143 patients or less than 10 per cent of the 1,600 patients seeking relief for dysphagia.

## METHOD OF X-RAY EXAMINATION

The type of examination varies with the lesion suspected. It is not sufficient to give the patient barium to swallow and merely observe the patency of the food passage. The reaction of the muscles of deglutition, the tonicity of the œsophagus, the activity of peristalsis, and the presence of stasis must all be noted.

If we are to pick up the early changes in the wall of the œsophagus before the lesion is extensive enough to produce obstruction, a very careful examination is necessary.

The procedure we have found most satisfactory is first to fluoroscope the patient while he drinks a thin barium mixture. If this is negative a heavy, thick paste is given which travels slowly enough for the entire œsophageal wall to be examined. The patient is fluoroscoped while drinking the barium mixtures in both the erect and prone positions. If these show nothing the patient is again given the thin barium mixture and after the bulk of the bolus has passed into the stomach a film is taken with the patient in the right oblique position.

If the œsophagus is normal, thin lines will be seen on the film which indicate the normal

mucosal folds (Fig. 1). If the œsophagus does not properly collapse upon itself, interruptions or widenings of these folds may be noted. This method was first described by Schatzki in his work on the delineation of the mucosa of the œsophagus, in which he was able to show varices, small ulcerations, and infiltrations which are entirely lost if the lumen is filled with barium.

## FOREIGN BODIES

The trauma caused by the lodgement or passage of a foreign body through the pharynx or œsophagus is a very frequent cause of dysphagia. Foreign bodies were found to be present in 183, or 30 per cent, of all those who were referred as suspicious. This is one œsophageal condition more common in the first decade of life (Fig. 2).

Considerably over 90 per cent of foreign bodies lodge in the pyriform sinuses or upper third of the œsophagus.

Because the majority of foreign bodies lodge in the upper portion of the œsophagus, our routine procedure is to take a film of the neck in the lateral position before the patient is given any barium (Fig. 3). This will reveal the presence of foreign bodies which usually are considered non-opaque, such as chicken bones and fish bones. On the lateral view, in the average sized patient, the œsophagus and periesophageal structures measure about one-half the width of the trachea.

If the foreign body is not located on the lateral view, a search must be made for it with the aid of a heavy barium paste, for if present the barium will adhere to it and will not be washed off by subsequent swallowing of water.

We were able to locate all of the foreign bodies in our cases by either the plate or fluoroscopic method.

If there is œdema and scarification of the mucous membrane from trauma in the passage of the foreign body, there will be delay in the transit of the barium and a variation from the normal mucosal pattern, but one or two swal-

<sup>1</sup>Presented in the symposium on "The Œsophagus" before the Clinical Congress of the American College of Surgeons, Boston, October 15-19, 1934.

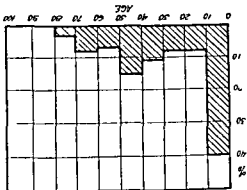


Fig. 2. Graph showing the age incidence of foreign bodies in the esophagus

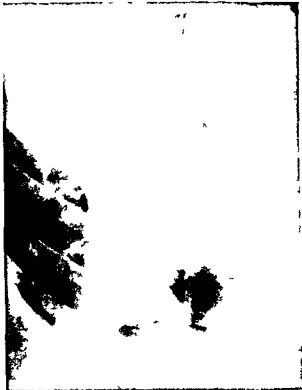
Posterior lesions are included in the upper third group. These figures are at variance with percentage of occurrences found by other observers. Where specimens of carcinoma were taken, the types were as follows: epidermoid type, 152 cases; adenocarcinoma, 28 cases; non-classified, 18 cases.

The majority of patients gave dysphagia and not pain as the initial symptom. Pain is apt to be the first symptom, however, if the lesion arises from the deeper layers of the mucosa and causes mediastinal growth rather than extensive obstruction of the lumen.

The incidence of cancer of the esophagus is low compared with its occurrence in other parts of the body. U. S. Vital Statistics show it to be responsible for 1 1/2 per cent of all of the deaths from cancer (Table II). Watson, at the Memorial Hospital in New York, reports 2.5 per cent. Abel reports cancer of the esophagus responsible for 5 per cent of all cancer deaths.

Cancer of the esophagus has been well termed the most melancholy chapter in medicine. It is unfortunate that the average duration of symptoms in patients found to have cancer is over 5 months before seeking relief, for by this time they are well beyond any hope of surgical removal or cure by radiation treatment. The only encouraging feature of the matter is that less than half of the patients complaining of difficulty in swallowing, in the cancer age, have the disease. The other half, for the most part, i. e., those who do not have cancer, are completely cured or greatly relieved by surgical or medical measures.

Fig. 1. Roentgenogram showing barium in the mucosal folds of the normal esophagus—line sharp lines parallel



lows of water will wash off the barium from any such area of abrasion.

When fluoroscopic examination was negative and there were clinical symptoms suggestive of the presence of a foreign body, pre-oral examination was carried out which showed that the continued irritation was due to trauma or infection at the site of trauma.

The types of foreign bodies found in these cases, were, in order of their occurrence: small lead toys, pieces of wood, glass, and a variety of hardware.

## CANCER

Of the remaining 878 patients in this series, complaining of dysphagia from some cause other than the swallowing of a foreign body, 350, or 40 per cent, were due to malignancy.

(Table I)

The ages ranged from 30 to 78 years, the greatest number being in the seventh decade (Fig. 4). Men predominate over women 6 to 1. In this series, malignancy occurred in the esophagus as follows: upper third, 124 cases; middle third, 103 cases; lower third, 132 cases.



Fig 9 Web at the mouth of the esophagus opposite the fifth cervical vertebra

by use of his diagnostic bag proves his contentions beyond doubt. There were 101 women and 34 men in the series or a ratio of 3:1. The average age at first examination was 40.1 years, the age varying from 16 to 68 years. The average cancer age was 59.2 and the average age for pulsion pouches, 63 years.

#### FIBROSIS OF THE UPPER END

When infection and consequent fibrosis involves the upper third of the esophagus there is a fusiform narrowing but no dilatation above the point of constriction because of the ease with which food can be regurgitated back into the pharynx. We found this condition accounted for dysphagia in 96, or 11 per cent of our series. The symptoms are usually of some years' standing before the patients seek relief. The onset is so gradual that the patient is seldom able to recollect the probable cause.

This condition occurs more frequently in women than men.

The ages of patients were between 26 and 82 but the greatest number were in the fifth decade of life.

On X ray examination a thick barium paste will show a smooth fusiform narrowing of the upper end of the esophagus (Fig 8). The esophagus is not deviated from the midline,

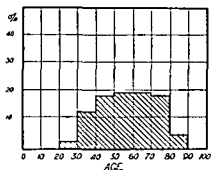


Fig 10 Age incidence of webs of the esophagus in 114 patients

as it might be by an external pressure, and the mucous membrane pattern is entirely normal.

The condition produces no pain or distress except the inability to swallow a large bolus of food or, in extreme cases, even semisolids or liquids.

On endoscopic examination it may be impossible to pass the large esophagoscope and often the medium sized one will not pass through the stricture. The mucous membrane appears perfectly normal and shows no evidence of previous infection. Because of the fibrosis very little relief is to be gained by dilatation. The psychological effect on the patient of the passage of bougies is one of reassurance, and gives the patient a sense of relief although the roentgenological picture remains unchanged.

#### WEBS

The next most common lesion occurs in the mucous membrane with the formation of partial diaphragms of mucous membrane, or webs, with either a central or excentric opening. This type was first described by Mosher in 1927.

It is usually possible to obtain a definite history, such as trauma from swallowing a foreign body, or superficial ulceration of the mouth or pharynx, followed in due time by dysphagia. These lesions are frequently found opposite cervical exostosis.

The roentgenological picture (Fig 9) is radically different from that of fibrosis. There is an abrupt, sharply defined narrowing at the location of the web. After passing this point the lumen regains its normal outline. This





Fig 11 Aneurism of the arch of the aorta causing pressure on the esophagus—syphilitic ulceration of the esophagus is rare

picture is so typical and definite that there is little chance of confusing it with other lesions. This condition existed in 114 patients, or 13 per cent. The average age was about the same as that for fibrosis of the upper end. Eighty-four per cent of these were females and 16 per cent males (Fig 10). Patients are susceptible to exacerbations of their dysphagia due to trauma from rough food. The marked relief that can be given by breaking or stretching this thin diaphragm of mucous membrane by use of instruments through the esophaguscope is spectacular.

#### EXTRINSIC CAUSES OF DYSPHAGIA

Extrinsic causes of dysphagia occurred in 31 cases, or about 3 per cent.

The esophagus may be constricted by external pressure along any part of its course. In one series, 25 out of the 31 cases were located in the upper third of the esophagus. In the neck region the esophagus is located in close relationship to a number of important structures, which are often the seat of primary or metastatic malignancy, such as tumors of the thyroid and larynx and metastatic masses in the glands.

Fig 12 Lye burns may produce serious strictures at various levels, with normal esophagus in between. This patient (4 years) had one at the level of the episternal notch and another in the lower third.



In this group of cases we have some of the most interesting diagnostic problems. It is only by the most careful and painstaking work, from a roentgenological and endoscopic standpoint, that external pressure can be differentiated from actual involvement of the wall of the esophagus such as occurs in cancer arising from the deeper glands of the esophagus, for in such a lesion the bulk of the tumor mass is apt to be in the mediastinum with very little showing on the mucosal side.

**Burns.** There appears to be a decrease each year in the number of cases of esophageal burns and resulting strictures from the swallowing of acid or alkaline corrosives. There were 40 such cases in our series, or about 0.5 per cent. They were evenly divided between the sexes.

There are twice as many strictures located in the middle third as in the upper part. This is probably due to the protecting covering of saliva in the mouth and pharynx and upper end of the esophagus, through which the liquid passes rapidly, there is a normal slowing up of ingested matter at about the level of the arch of the aorta.

When the mucous membrane alone is involved there result thin membranous strictures which simulate the webs so often found

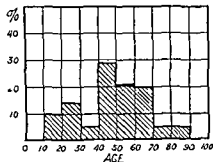


Fig 13 Age incidence of paralysis of the muscles of deglutition

Twenty five per cent of the stricture cases were of this type. If the mucosa is entirely denuded by the caustic fluid and there is a gluing together of the submucosal structures there results a tubular stricture varying in length and diameter. Seventy five per cent of the stricture cases had a tubular stricture involving one half or more of the lower part of the œsophagus.

#### PARALYSIS

Paralysis of the œsophagus is a rare condition and was not encountered in this series, but paralysis of the muscles of deglutition is not uncommon and was noted in 40 patients (Fig 13). There were 15 males and 31 females with the average age 47 years.

The symptoms are so difficult to differentiate from those due to obstruction of the upper end of the œsophagus that it seems logical to consider this group of cases in speaking of diseases of the œsophagus.

The paralysis is always of central origin and may be due to any one of various etiological factors: an infection such as poliomyelitis, a localized central hæmorrhage, brain tumor, fracture at the base of the skull with hæmorrhage, and Parkinson's disease.

The muscles of the tongue may be sluggish and unable either to form the bolus properly or to give it its initial push into the pharynx.

The findings are very striking on fluoroscopic examination. Instead of being assisted by normal muscular action, the ingested material drops by gravity into the pharynx and completely fills up this area. The pyriform sinuses are entirely flaccid (Fig 14). The œsophagus



Fig 14 Paralysis of the muscles of deglutition due to cerebral hæmorrhage. Note the dilated pyriform sinuses. The lack of motion when the patient attempts to swallow is striking.

does not open to receive the bolus as it normally should and the barium remains in the pharynx until expectorated.

Cases of localized cerebral hæmorrhage, which presented no other manifestation of their presence, accounted for less than half of our cases. The history is characteristic; the condition is first realized when the patient attempts to drink or swallow food and is unable to do so.

After an interval of a few days, the patient's ability to swallow returns and the function may be entirely restored. On endoscopic examination with the œsophagoscope, nothing unusual is noted except flaccidity of the pyriform sinuses. There is no evidence of spasm or closure about the mouth of the œsophagus.

#### POUCHES

Pouches of the œsophagus are rarely recognized during life because they do not produce obstruction and seldom produce symptoms of dysphagia. They comprise less than 1 per cent of our cases.

They are likely to be found during the swallowing of barium in the routine examination of the œsophagus in gastro intestinal X ray examination.

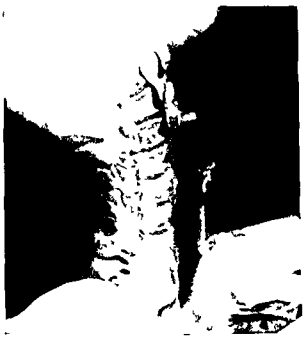


Fig. 15. Zenker's pulsion pouch of the lower pharynx, showing barium in the oesophagus, the neck, and the pouch. Symptoms in this case were sensation of lump but little obstruction.

The most common site is the middle third of the oesophagus in the region of the bifurcation of the trachea, and the most frequent type is the traction variety. Traction is caused by the pull exerted on the oesophageal wall by healing mediastinal glands which are also attached to some less yielding periesophageal structures such as the trachea and dorsal spine. These diverticula are very often conical in shape, although occasionally sacculated ones, which contain food, do occur. Rokitsansky, in 1840, first described the traction type. The next most frequently described pouch is the pulsion type which occurs in the lower third of the oesophagus just above the diaphragm. Fortis reported a case of a pulsion diverticulum which enlarged so much that it produced cardiac embarrassment which was relieved only by washing out the pouch with a stomach tube.

In our series, no such severe symptoms were reported, but there was substernal distress in 2 cases.

Sacculations of the oesophageal wall may arise above a location of stenosis. Six cases of this type appear in the literature and the seventh case was described by Mosher at the same meeting of the American Bronchoscopic Society.

The first case of this type was reported 170 years ago by Ludlow and since then there have been scores of papers written reporting hundreds of cases. The condition accounted for only 3.2 cases or about 3 per cent of all of our dysphagia cases.

The severity of the symptoms produced by these pouches is in direct proportion to the size of the pouches.

Various theories have been advanced as to the etiology of the herniation of the mucous membrane through the fibers of the inferior constrictor muscle. Jackson believes there is an incoordination in the neuromuscular mechanism, which results in a failure of the lower part of the constrictor to open when the bolus arrives at this level, this, momentarily, produces an increased pharyngeal pressure.

The ages of our patients varied from 45 to 83 years and averaged 63 years (Fig. 16). The ages coincide quite closely with the carcinoma cases, which makes the diagnosis of great importance.

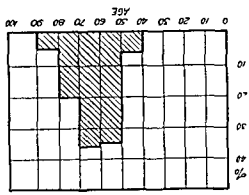
In Lahey's report of 21 cases the average was 67 years.

Males predominated over females 41 to 24 men and 8 women.

Diagnosis is made very readily by X-ray examination. The pouch in the well developed case appears to be a continuation of the lower pharynx while the mouth of the oesophagus appears as an opening high up on the anterior wall of the pouch. This condition produces an inability even to swallow liquids. Swallowing motions are accompanied invariably by gurgling sounds. The pouch may become

### PHARYNGEAL DIVERTICULA

Fig. 16. Age incidence of pharyngeal pouches



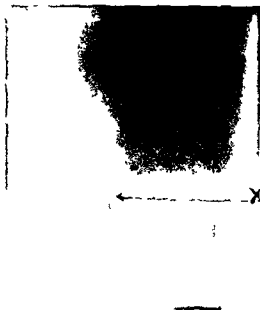


Fig. 17. Ulcer of the lower end of the esophagus with a typical ulcer fleck x in an area of scar tissue at the lower end of the esophagus. Note spasm a short way above the ulcer.

filled up with food or air and produce a palpable swelling in the throat which may cause pressure on the laryngeal nerve.

The X ray findings make any error in differential diagnosis quite unlikely.

The treatment is the surgical elimination of the pouch. If this is impossible the esophageal opening may be dilated, this at least benefits the patient psychologically.

#### ULCERS OF THE ESOPHAGUS

Young adults comprised most of our 14 cases of ulcer of the esophagus. The lesion occurred most commonly in the lower third of the esophagus. Clinically, the outstanding symptom is the substernal pain accompanied by dysphagia. The pain is apt to be intermittent as is the case in ulcers elsewhere.

The fluoroscopic examination reveals considerable spasm of the esophagus. After the patient is given barium, there is a fleck remaining in the ulcerated area. It may be difficult to confirm the X-ray findings with

the esophagoscope because of the scar tissue already formed about the ulcer by the time the patient seeks relief.

These ulcers are prone to occur in islands of aberrant gastric mucosa which are infrequently found scattered about the mucous membrane of the esophagus, more common in the lower third.

Ulcerations of the esophagus from tuberculosis occurred in but 1 patient in our series, who already had had extensive pulmonary and mediastinal tuberculous involvement. Differential diagnosis of this case was made possible by microscopical examination of a portion of the ulcer.

Syphilitic ulceration is extremely rare. Guisez in 3000 cases found but one of which he could be sure. Less than a dozen have been reported in the literature and there were none among our cases.

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## THE ESOPHAGUS

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It is my purpose to review the work on the esophagus which has been done in Boston and to give the Boston point of view.

*Exostosis and webs of the esophagus* Webs of the esophagus were first put on record in Boston a good many years ago. The cause of webs was at first indefinite, the only ready explanation being an ulceration of two opposing surfaces of mucous membrane caused by appropriate bacteria. I am excluding, of course, strictures caused by caustics. Later it was found that exostosis of the cervical vertebrae was often associated with webs of the upper end of the esophagus. These spurs can be so sharp as to pierce the esophagus and give bleeding. The first of the cases was discovered in this way. We all know that exostosis or lipping of the cervical vertebrae is common in the orthopedic clinic, and in the majority of such cases there is no difficulty in swallowing. However, in patients who come to the hospital with difficulty in swallowing we have found that exostoses are a fairly common cause.

Webs can occur anywhere about the upper end of the esophagus in the pyriform sinuses, where the symptoms are those of a small pouch, that is, the patient regurgitates small amounts of food from time to time and has difficulty in swallowing any large bolus of food. They occur also behind the cricoid cartilage.

The webs are placed so high that the obstruction caused by them causes food and fluid to spill over into the larynx, thus producing violent laryngeal spasms. This makes meal time for the patient with a web a time of terror. Such patients, therefore, cut their diet to a minimum and lose weight markedly.

The treatment of the web, especially if it occurs in the pyriform sinus, is to put it on the stretch by ballooning it with air and then to bite out a generous piece of it. This is followed by the periodical passage of a bougie. Occasionally a web will make an almost complete diaphragm back of the cricoid. This

is generally has a central opening. Such a web had such a web, who had so much difficulty from it that she had to take all her meals in the bathroom.

There is another type of web, sometimes single and sometimes rather a periesophageal thickening for an inch or more. This is found below the cricoid cartilage. We have known about these webs perhaps for the last 10 years.

Dr Macmillan and Dr Smyth were the first to focus attention on this type. They are easily dealt with by stretching under ether followed by the periodical passage of a bougie, especially by the passage of the mercury bougie which is safe to give the patient for him to pass on himself.

For a long time we were in doubt as to the cause of such webs but, as I shall show later, we now have abundant cause for them in infection of the esophagus in acute or chronic disease.

*Pouches of the esophagus* I should like first to dispose of pouches which spring from the esophagus at the bifurcation of the trachea and those which occur at the lower end of the esophagus. Pouches around the bifurcation are not uncommon. They are generally tuberculous in origin, being due to the healing of a wall of the esophagus. So far as my experience goes, they give very few symptoms and require little if any treatment.

Pouches of the lower end of the esophagus I have seen but few of. I have an autopsy specimen given to me by Dr McGregor, which shows three small pouches in vertical line, one above the other. I have seen one or two single large pouches. My experience with this type of pouch has not been sufficient to discuss them from the standpoint of treatment. They might readily give symptoms of obstruction from their size or from twisting on their pedicle.

*Pouches of the upper end of the esophagus or esophageal hernia* Pouches of this type, of



Fig 1



Fig 2

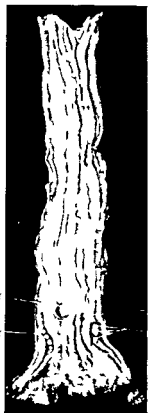


Fig 3

Fig 1 Mesenteric thrombosis. Photograph of the lower end of the esophagus showing sharply defined ulcers. The whole esophagus showed a marked infiltration with lymphocytes. *x* Ulcer. (Photograph by Dr Ireland)

Fig 2 Cirrhosis of the liver. The upper figure shows greatly dilated esophageal veins. *x* The lower figure dilated veins *x* in the stomach. In one place there is a streak of hemorrhage *z* reaching the surface. This patient died of

hemorrhage. At autopsy the bleeding point could not be found. Often it cannot be determined.

Fig 3 Atrophic cirrhosis of the liver. The picture shows, *x*, cysts projecting into esophageal lumen and cysts under mucous membrane. In chronic infection of the esophagus infected glands and cystic gland ducts are common.

course are fairly common. I believe there is an embryological background to these pouches because they are normal in certain animals; for example, the pig. In the pig embryo there are two pouches, an upper and a lower. Only the lower however persists. In the embryo of man in what might be called the pig stage there are two similarly placed pouches. Both, however, disappear at birth. The function of the pharyngeal pouch in the pig is to house the very large arytenoids peculiar to this animal. The anterior attachment of the esophagus is to the back of the arytenoids in the pig as well as to the back of the cricoid.

Many years ago I found it was common in pouches in man to have the opening of the esophagus asymmetrical, that is, one pyriform sinus is obliterated. This asymmetry of the mouth of the esophagus, as I reason it,

puts the tension on the inferior constrictor off center in swallowing and could readily play a part in the formation of the pouch or hernia.

Early in my career I devised an operation for pouch of the upper end of the esophagus, namely, I slit the common wall between the esophagus and the pouch. This resulted in immediate relief for the difficulty of swallowing in 6 such cases operated on but the seventh was a tragedy by infection of the mediastinum, followed by sloughing of the common carotid. This naturally led to the abandonment of the procedure. For a good many years now I have been referring such cases to Dr. Lahey for the two-stage external operation under novocain. My feeling is that the problem of dealing with this type of pouch is successfully settled. It is a great comfort to have it so settled. Thus I feel is due largely to

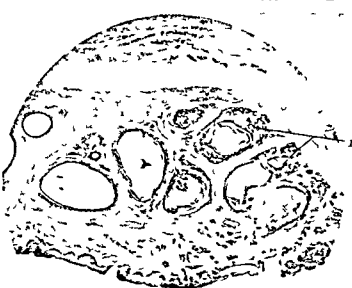


Fig 5 Old peptic ulcer followed by obstruction and peritonitis. The section shows dilated gland ducts and chronic infection of the glands. 1, Lymphocytes in glands

*Foreign bodies* As you know, almost every type of small hardware finds its way at times into the esophagus. With the insane, sizable objects like forks or spoons occasionally are swallowed. The great point about foreign bodies is to remove them without lacerating the esophagus, because given the right bacteria the posterior mediastinum inflicts more readily even than the peritoneum or the dura of a bougie with or without ether, is a potential tragedy. The only foreign body I shall speak



Fig 6 Dynamic colon. The photomicrograph shows hemorrhage into the longitudinal muscular layer. Hemorrhage slides from this case showed periosophagical

Fig 4 Atrophic cirrhosis of the liver. The illustration is a cross section of the esophagus shown in Figure 3. The esophagus is riddled with cysts

Dr Lahey. Now that we have Dr Churchill at the Massachusetts General Hospital, who is specializing in chest and neck work, patients suffering from such conditions are naturally referred to him.

*Strictures of the esophagus* I have a little to add as to the treatment of such cases. As we know, they are more commonly caused by the swallowing of caustics, generally one of the commercial washing powders. Owing to legislation originated by Dr Chevalier Jackson, washing powder contains dispensing sodium hydroxide are required by law in many states to be labeled *poison*. The public has been educated to the danger of these powders, and in a desperate case, the best procedure is to put a feeding tube in the stomach and to have the patient swallow a string, to be used for retrograde bougienage. Of late, I have been using fluoroscopic dilatation of narrow strictures with metal tipped bougies. This is a dangerous procedure and is used only in tight strictures which have to be picked apart slowly and brought to a sufficient size to allow the patient to swallow the string. I have lately had 2 such cases. Dilatation was begun with the bougie tipped with a flexible spiral wire under the fluoroscope, I found it possible to pick my way through these two strictures, one 4 and one 6 inches in length.



Fig. 7



Fig. 8

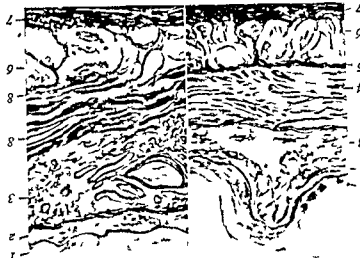
Fig. 7 Adynamic colon. The first figure shows intramuscular hæmorrhage, the second periosophageal hæmorrhage. (See Fig. 6)

Fig. 8 Cholecystitis. The photomicrographs show a great dilatation of the superficial vessels and a pronounced infiltration with lymphocytes. These two findings indicate chronic infection. There is a myoma in the circular layer. The section is taken from the lower end of the œsophagus. The first illustration is a low power view showing the full section of the œsophagus. The second photograph is a high power view of the myoma.

about is the open safety pin, point up. The first safety pin closer I invented years ago after a tragedy following the attempt to remove a very large safety pin, almost a blanket pin, from the œsophagus of an adult. This closer has been modified and its grandchild is now in successful use in this hospital. The youngest child from whom I have removed a safety pin was 4 months old. In dealing with an open safety pin, point up, select the safety-pin closer which appeals to you—there are a number of good ones on the market—practice

with it outside the body and then under the guidance of the fluoroscope close the pin and remove it. If this cannot be brought about speedily, the thing to do, in my opinion, is to put your pride in your pocket and push the safety pin into the stomach. A try, of course, can then be made, after the fashion of Jackson, to close the pin in the stomach. Again, if this is not quickly successful, the pin should be left to nature. For the first 48 hours it should be watched by the fluoroscope or X ray plate to see that it is moving. If it halts, it generally





6 Sig

Fig 9 The first photograph shows a specimen from a normal oesophagus. The specimen shows the normal amount of connective tissue. The largest amount is between the

[illegible][illegible]

We had two instances of this. When it was recognized the pin was removed by opening the stomach. Usually the pin leaves the stomach fairly promptly and within a week it is found in the bedpan. I have personal knowledge—and this happened outside the hospital—of but one case in which a safety pin, after it had left the stomach, perforated the intestinal wall and caused a fatal peritonitis.

*Carcinoma of the esophagus* There are 2 types of carcinoma of the esophagus, epidermoid, or squamous cell carcinoma, and adenocarcinoma. Adenocarcinoma is less common and is found usually at the lower end of the

Fig. 2. Old peptic ulcer followed by obstructive and muscular layer peritonitis. The photograph shows a fibrous membrane at the lower end of the esophagus. Also a little more than the length of the specimen, the muscularis of the esophagus are much thickened. 7, fibrous tissue.

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esophagus I have lost all the usual procedures in connection with cancer of the esophagus, from curiethage to X-ray and radium. All my life I have been pursued by cancer of the esophagus and I have always said that I stand as helpless before it today as I did at the beginning. Within the past 6 months, however, there have been some hopeful rays at our hospital with heroic doses of radium. In epidermoid carcinoma there are one or two promising results. No more have been obtained in adenocarcinoma. I feel that the thoracic surgeon might be called the liver approach end of the esophagus is likely.



Fig. 11 Old peptic ulcer followed by obstruction and peritonitis. This section is taken from the fibrous constriction at the lower end of the œsophagus. It shows almost no muscular tissue. 1 Fibrous tissue.

best result from surgery. I expect that the thoracic surgeon will add to his accumulating honors by reporting successful operations of this character in the near future.

**Plummer Vincent syndrome.** The medical service of the hospital has referred a few patients labelled as having the Plummer Vincent syndrome. Such patients did have a smooth tongue, anemia and a slight difficulty in swallowing. In all of them a careful œsophageal history revealed signs of œsophageal obstruction for a considerable time, that is from 1 year to 4 or 5 before the appearance of the anemia. The X-ray picture in these patients showed slight web of the œsophagus. This was confirmed by examination with the œsophagoscope. As far as the cases go which I have seen, I feel that the primary and essential lesion was a web of the œsophagus, the anemia being secondary. I have not seen enough cases to be convinced that the disease called Plummer Vincent syndrome is an actual medical entity.

Hernia of the fundus of the stomach through the œsophageal opening of the diaphragm was first reported, I believe, by the late Dr. Morrison of Boston. He is the second Boston man

to become a martyr to X-ray burns. Oddly enough the first one, Dr. Walter Dodd, Dr. Morrison assisted for years. In order to make a diagnosis of this condition the patient has to be examined in the prone position. Most of our œsophageal examinations are made in the upright position. I have seen but few of these cases and know them mostly second hand.

Up to within a few years ago the common pathological conditions found in the œsophagus were strictures due to caustics, malignant disease, and pharyngeal pouches. In the literature there were references to acute infection of the œsophagus, generally of unknown origin, and to ulcers. Tuberculosis was mentioned occasionally but not often, so was syphilis. I have never seen a case of syphilis of the œsophagus. I have seen only 2 or 3 ulcerations which were probably tuberculous. I have seen a few cases of pemphigus.

**Ulcer of the œsophagus.** Speaking of ulcer of the œsophagus there is no reason why ulcer should not occur especially at the lower part, since this is histologically comparable to the upper end of the stomach, and ulcers of the fundus of the stomach are common. Years ago I learned to be suspicious of my findings with the œsophagoscope at the lower end of the œsophagus. It is hard to be sure of what



Fig. 12 Central pneumonia. The section shows three thrombosed veins. 1, Thrombosed vessels.

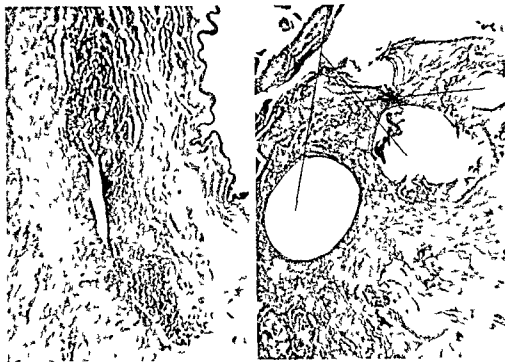


Fig. 13 Infectious thrombophlebitis  
esophageal abscesses. The first photograph shows three peri  
wall near the periesophageal abscess, 1

you see at the end of a 16 inch tube, especially when, in looking for an ulcer, you have to use it edge on. This makes me doubt the frequency of true ulcer as I find it reported in the literature. The slightest maladjustment of the end of the examining tube causes the mucous membrane to bleed and the bleeding point may be easily mistaken for an ulcer. Frankly, I have seen very few ulcers of the esophagus of which I could be sure. As I said a moment ago, the natural place for the X-ray picture shows a small pea-like protruberance in this locality, I feel it is reasonable to assume that this is an ulcer. We have only 3 or 4 cases with such a finding.

*Cirrhosis of the liver and the esophagus* It has long been known that cirrhosis of the liver interferes with the venous drainage of the esophagus and leads to dilatation of the esophageal veins. In some instances the veins are so large that they will show in the X-ray film. Such cases may be associated with hemorrhage which at times is fatal. It is not necessary, however, that the dilatation of the veins be of the extreme type for hemorrhage to occur. The pathologists say that it is often hard to find the source of the hemorrhage in fatal cases. Figure 2 is of a case in point. Not only are the veins enlarged in cirrhosis of the liver but the ducts of the glands become cystic and are often infected. I have a number of specimens showing the esophagus muddled with small cysts, and 2 or 3 specimens in which there were single cystic enlargements. Fully a centimeter in either diameter (Figs 3, 4, 5).

*Danger of esophagoscopy* For years I have maintained that every examination of the esophagus, even the simple passage of a bougie, is a possible tragedy. I have had a few tracheas with both procedures. The general impression is current among the medical staff of our hospital that esophagoscopy is too dangerous a procedure, and they do not feel safe in referring cases for esophageal examination. Those of us who are doing esophageal work have known all along that our percentage of tragedies was low. However, in order to have the actual statistics I had them looked up. During the past 12 years, there have been 19 mortalities associated with this examination and probably



Fig. 14. Old peptic ulcer followed by obstruction and peritonitis. The photomicrograph shows dilated glands in the oesophagus with marked infection. The high power view showed a definite abscess in the mucosa with marked infection throughout the whole area.

due to it. This makes a mortality rate of a little over 1.50 per cent. I defy any medical man who is not simply a bedside watcher to show me any surgical procedure with a smaller mortality rate.

The cases of stricture of the oesophagus numbered 294, with 6 mortalities reported in this group. Webs of the oesophagus numbered 79 with 1 mortality, carcinoma of the oesophagus numbered 247, 9 mortalities, foreign bodies of the oesophagus including all kinds simple and the most difficult, numbered 285 with 2 mortalities, cases of cardiospasm numbered 33 with 1 mortality.

TABLE I.—MORTALITY RATE FOR OESOPHAGOSCOPY

Oes. phag. scopes	October 1922 to August, 1934	Mortalities
Stricture of oesophagus	294	6
Web of oesophagus	79	1
Carcinoma of oesophagus	247	9
Foreign body of oesophagus	285	2
Cardio spasm	33	1
Total	938 (15 + 7) 19	

Remove the carcinoma cases (these are fatal cases anyway) and the percentage is less than 1 per cent.

*The oesophagus at birth.* I have specimens showing that the oesophagus can be markedly infected at birth. I have found 1 case of ulcer, this occurred at the lower end. Also I have 2 or 3 specimens showing a backward bend of the terminal portion of the oesophagus. In other words, there is abundant proof that the

oesophagus can be in trouble before birth. In a children's hospital, it is not uncommon to find malformations of the oesophagus due to congenital syphilis. In our hospital we do not see this type of case. Speaking of children brings up the question of a congenitally short oesophagus. Here again I have no experience with children to base my opinion on. However, I do know that in the adult the oesophagus can be shortened by the contraction of adhesions caused by a lye burn in childhood, or to be specific, a young woman of 20 had a lye burn of the oesophagus at 2 years of age. At the present time, that is, after 18 years, the stomach is pulled into the chest a third of the distance to the arch of the aorta. At birth it is not uncommon to find hæmorrhage into the oesophagus or marked peroesophageal hæmorrhage. The pediatricians maintain that this is due to asphyxia occurring during delivery. I have a feeling, however, that it may be associated with sepsis.

*Hæmorrhage into the oesophagus.* Peroesophageal hæmorrhage is not uncommon in the adult, hæmorrhage into the oesophagus itself also is not rare. I have 1 specimen in which hæmorrhage into the lower end of the oesophagus was sufficient to rupture both layers of muscle. This was a septic gall bladder case and I have it in mind that the hæmorrhage harks back in this case to sepsis (Figs 5 and 6).

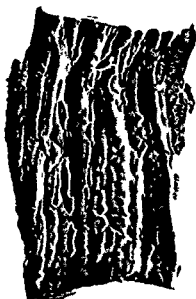
*Narrowing of the cardia at birth.* I have 3 specimens showing marked narrowing of the cardiac end of the oesophagus at birth with dilatation of the oesophagus about the stricture area. Congenital narrowing of the pylorus has long been known. If the operative procedure for the treatment of congenital stenosis of the pylorus should in any instance prove unsuccessful the surgeon has a ready alibi in the possible presence of a narrowing at the cardia as well as at the pylorus.

*Myoma of the oesophagus.* Myoma of the oesophagus was new to me up to a few years ago. I have lately accumulated 4 or 5 specimens of this condition. It has been reported in the literature but is exceedingly rare. It is important only from the fact that should the myoma grow after the fashion of these tumors in the uterus, it could easily be a cause of trouble (Fig 7).



Fig 13 Atrophic cirrhosis of the liver. The vessels throughout this esophagus were greatly dilated. The photomicrograph shows a gland which is adherent to the esophagus. Over this the esophageal muscles are replaced by fibrous tissue. On the opposite esophageal wall, the enlarged superficial vessels are surrounded by dense fibrous tissue. 1, Muscular fibers; 2, fibrous tissue; 3, gland.

Fig 16 General peritonitis. The photograph shows many patches of exudate.



*Septa of the esophagus* A number of years ago I came across examples of partial transverse septa in the lower portion of the esophagus. I found them only in the adult. They weaken the esophagus by making a band of scar tissue partially encircling its lumen. I feel that they hark back to infection spreading along the sheaths of the blood vessels from without in. When they are multiple they divide the esophagus into segments. Their clinical importance lies in the fact that if they engage the point of a bougie or the end of the esophagoscope they might easily lead to a rupture.

*Infection of the esophagus in acute and chronic disease* Early in my career in dealing with cases of so called cardiospasm I became convinced that spasm played a minor part in cases as they came to our hospital. Under the fluoroscope there are generally no signs of penstalsis, therefore, of course, no signs of spasm. In the last 10 years Dr Macmillan and I cannot have seen more than 8 or 10 cases in which spasm was a prominent feature. As I have just said, in most of our cases there is no spasm demonstrable. Examination with the esophagoscope convinced me that many of these cases were really cases of stricture of the terminal portion of the esophagus. I found that in many of them the structure consisted of only a slight gluing together of the

The frequent finding of webs at the upper end of the esophagus and below the cricoid cartilage not associated with cervical exostosis came the finding that the esophagus can be infected in acute disease as well as in chronic—

In all of the specimens there was a fibrosis of the terminal portion of the esophagus associated with a disorganization of the musculature. The esophagus above the terminal portion, that is, in a long standing case, showed fibrosis also but to a less extent. This made me feel that the essential lesion in cardiospasm is a fibrosis of the terminal portion of the esophagus due to infection from neighboring organs, especially the gall bladder and the thorax. (Figs 9 and 10)

The frequent finding of webs at the upper end of the esophagus and below the cricoid cartilage not associated with cervical exostosis came the finding that the esophagus can be infected in acute disease as well as in chronic—



Fig 17 General peritonitis The photomicrograph shows an infected superficial ulcer over which there is a marked exudate

for example in pneumonia pyæmia and chronic nephritis (Figs 11 12 13.) A further finding was that in chronic infection of the œsophagus and in the degenerative diseases like arteriosclerosis, there is marked increase



Fig 18 Mesenteric thrombosis This photomicrograph shows a superficial ulcer of the œsophagus Other sections showed chronically infected glands In one section there was a blocked and infected duct which had broken down into an abscess

in the fibrous tissue of the œsophagus, in many cases amounting to an obliteration of parts of the circular or longitudinal muscular layers. It became evident, therefore, that the œsophagus could be infected not only from without and from the blood stream, but probably could be infected from within by way of the glands. In other words it is extremely common in chronic infection to find an increase of the subepithelial connective tissue of the œsophagus. These findings, plus the fact that perioesophageal hæmorrhage and hæmorrhage into the musculature of the œsophagus occur, give I feel, abundant cause for webs or strictures of the œsophagus at any part of its course. It becomes unnecessary therefore, to rely on spasm, especially at the lower end of the œsophagus, as the chief cause of œsophageal obstruction (Figs 14 15, 16.)

*Cardiospasm or fibrosis of the terminal portion of the œsophagus* I feel, as I just said, that spasm plays but a minor part in the condition commonly known as cardio-pasm. I have had a sufficient number of autopsy specimens to prove to my satisfaction that the essential lesion is a fibrosis of the terminal portion of the œsophagus in the region of the

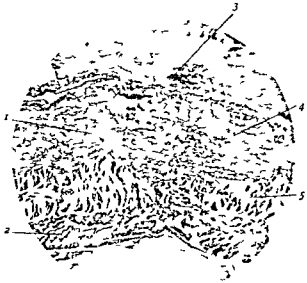


Fig 19 Acute infection The photomicrograph shows that the epithelium is lacking. In the subepithelial tissue the fibrin has in places turned to fibrous tissue. 1 Fibrin 2 longitudinal muscle layer 3 solitary follicle 4 fibrous tissue 5 circular muscular layer

crural canal. The obstruction may be initiated by a fibrosis of the edges of the crura, a periaesophageal fibrosis in the crural canal, or a fibrosis in the esophagus itself confined to the subepithelial connective tissue, or a fibrosis involving one or both of the muscular layers and destroying the greater part of the musculature.

Next in importance to the fibrosis which is due to infection of neighboring organs, is a backward bend of the terminal portion of the esophagus. I have mentioned finding this at birth. I cannot give the cause unless, again, it is an old inflammatory process. When fibrosis of the terminal portion of the esophagus has existed for any considerable time, this backward bend or trapping of the esophagus is a constant finding, and it is this backward bend associated with a vertical twist of the esophagus which keeps the obstruction going. For instance, after the terminal portion of the esophagus has been dilated a few times, the patient has marked relief, but under the fluoroscope there is practically always a fluid level at or near the arch of the aorta. This,

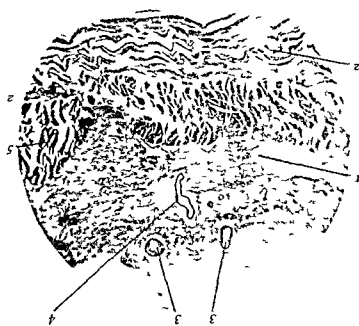


Fig 20 Acute infection. The photomicrograph shows that the epithelium is lacking. There is a subepithelial thickening due to a deposit of fibrin. Two gland ducts, 3, show hypertrophy of the epithelium which occludes one and almost occludes the other. 1, Fibrous tissue, 2, longitudinal muscle, 3, gland ducts, 4, dilated ducts, 5, circular muscle.



Fig 21 Coronary thrombosis, chronic infection. The photograph shows a loss of epithelium in the lower third of the esophagus. The microscopic slides showed an infiltration of the lymphocytes where the epithelium is lacking. The esophagus, therefore, shows chronic infection.

of course, is due to continued obstruction. Both Dr Macmillan and I firmly believe this recurring obstruction is due to the backward bend just mentioned plus a vertical twist. Spasm, of course, would do the same thing if



Fig 22 Atherosclerosis, chronic infection. The section shows a slight infiltration of Auerbach's plexus with lymphocytes. I have found a similar infiltration in this series of specimens perhaps five or six times. I have not yet found an infiltration with polymorphonuclear leukocytes. I still think that involvement of Auerbach's plexus in cardiospasm is a secondary and not a primary affair.



Fig. 23 above Passing the diagnostic bag. The position of the instrument table, the patient and nurse and the vertical fluoroscope are shown.

Fig. 24 Passing the diagnostic bag. In the first figure the roentgenologist is about to take a plate. In the second figure the diagnostic bag is in place, the assistant is inflating it, and the operator is watching the dilatation on the fluoroscopic screen.

we could find evidence of it in these cases. As I have said before, we have been unable to do this (Figs 17, 18, 19.)

When the diaphragm descends and the œsophagus is watched under the fluoroscope, it is seen to close. It opens when the diaphragm ascends. The point of closure is always at the beginning of the crural canal. This is the place where the diagnostic bag uniformly shows a fibrotic narrowing. In these cases, the X-ray film shows at the beginning of the crural canal either an annular constriction which is more marked on the left than on the right, due to the large left crus, or it shows a waist-like constriction.

*Examination of the œsophagus by fluoroscopic sight.* After modifying the Sippy bag by striping it with barium lines and tipping it with a spiral wire flexible finder, it became possible not only to examine the terminal portion of the œsophagus by sight but to dilate it by sight. The modified Sippy bag can be used for diagnostic purposes and for dilating the œsophagus. In my work, this instrument has proved to be the greatest advance in œsophageal manipulations which I have tried for the past 10 years.

*Barium picture of the lower end of the œsophagus.* In the typical case of fibrosis of the terminal portion of the œsophagus, this organ is



horizontal on a flat motionless diaphragm just before the esophagus gains the stomach it bends in goose neck fashion back to the right. In other words, the esophagus has two bends. These cases are dangerous to handle with the bag unless extreme care is used. Often it requires great patience to coax the spiral wire under into the stomach, and in some of the cases the fibrotic opening is so narrow that it will admit only the tip of the bag. In these old cases the esophageal wall is extremely thin, so that it is better, at least for a novice, to have the patient swallow a string and to use this as a guide to pass the bag. Furthermore, in these cases, unless the bag can be manipulated into the stomach either by sight or by the help of a swallowed string, I feel that the operation of anastomosing the terminal portion of the esophagus to the fundus of the stomach is the coming method of treatment. A number of such operations have been done in England and at least 2 in the Massachusetts General by Dr Churchill. The difficulty in all work on the lower end of the esophagus by the abdominal route up to the present time has been the inadequate and restricted surgical approach. However, by turning up the left lobe of the liver and mobilizing the lower end of the esophagus Dr Churchill demonstrated that the operative field can be much enlarged, and in the case in which I saw him use this procedure he had ample room to work. This is a great advance in operative technique.

*Esophageal instruments* In speaking of safety pins I have mentioned the safety pin closer which originated here in Boston. It is one of the most positive that has yet been devised and is practically fool-proof. The oval esophagoscope with the ballooning attachment also originated here, this too appeared a good many years ago. It is in constant use today. It is a great help in locating the opening of eccentric strictures and in making small new growths of the esophagus visible. It is also useful in locating the esophageal opening at the cardia in advanced cases of fibrosis where the esophagus bends markedly to the right and is greatly dilated, so that the folds make it very hard to find the opening into the stomach until the esophageal walls are put on

seen to come to an awl-like point at the beginning of the crural canal, and seems to be absolutely closed. However, in the great majority of cases the flexible tip of the diagnostic bag, which has a diameter of a *No 30 French*, with a little manipulation can be made to pass into the stomach. Furthermore in a certain number of cases a mercury bougie which is half again as large as the tip of the flexible ender will pass into the stomach. When I first came upon these findings they were rather startling to me. It is because the larger mercury bougie will pass in so many cases that many medical men hold to the spasm theory as a cause of the condition under discussion. However, if the diagnostic bag is passed in plate will show the typical fibrotic narrowing (Figs 20, 21)

*Treatment of fibrosis* The first procedure after gaining the patient's confidence and getting a preliminary X-ray plate, is to pass the diagnostic bag to locate the position of the fibrosis and its amount, and to begin the dilatation. In the usual case 3 or 4 dilations with a pressure of 3 or 4 pounds, at intervals of 2 or 3 weeks, will dilate the fibrosis sufficiently to do away with most of the difficulty in swallowing. When the esophagus can be dilated to normal, that is, up to 1 inch, under the pressure given above, the patient is instructed in the use of the mercury bougie and given one to use himself. In the beginning he generally passes the bougie once a day for a month or two and then gradually lengthens the interval. At first when the patient returns for observation and dilatation there is a fluid level at or near the arch of the aorta, showing that the backward bend plus the vertical twist keep up a certain amount of obstruction. A time comes, however, when the effect of the dilatation is permanent and the fluid line disappears. In other words, the patient comes in for examination with the esophagus empty. The majority of cases of fibrosis of the terminal portion of the esophagus can be successfully handled in this manner. When the condition has existed for as many as 30 years (I have seen such a patient), the esophagus is markedly dilated and sags decidedly to the right. The terminal portion bends to the left and lies

the stretch by ballooning. I have already spoken of the diagnostic bag striped with bari-um and tipped with the spiral wire under. By introducing the bag under the fluoroscope we can watch the under turn dead man's curve and see when the end of it enters the stomach. The present under has a very heavy end which more or less automatically falls into the stomach. It is only when the finder is well in the stomach of course that it is safe to carry the bag down.

The hollow bougie with the flexible metal staff is the most recent addition to my armamentarium and my feeling is that it will prove one of the most valuable especially for those who are not doing many œsophageal examinations. It occasionally happens in beginning the treatment of a patient with fibrosis that the under will readily enter the stomach but the tip of the diagnostic bag will not. In these instances the hollow bougie with the flexible metal staff is especially useful. Suppose the œsophagus is markedly bent to the right in such a case the flexible bougie fails to follow this bend. Without the flexible under it is very dangerous to pass this curve. The flexible under will take the curve readily and you see it make the turn under the fluoroscope. When the under has been manipulated into the stomach the flexible metal staff is inserted. This straightens out the bend of the flexible bougie and the operator has a straight and safe shot through the cardia. Bougies of any size can be fitted with the flexible under so that after the fibrosis has been dilated sufficiently with the diagnostic bag bougies of large size equipped with the under can be passed in place of the bag.

Speaking of dead man's curve this is the place where the tip of the ordinary flexible bougie will not make the turn hence it is the favorite site for perforations. The blind passage of the old fashioned elastic bougie has been accountable for many deaths and since the perforation almost always occurs at the point just mentioned this place has been aptly named dead man's curve.

*Metal tipped bougies.* Recently I have had two desperate cases in which the œsophagus was strictured to the diameter of a thread for about 4 to 6 inches. The attempt to pass a

thread in each case failed. Examination under ether gave the location of the œsophageal opening, which in both instances was eccentric and at the bottom of a sizable pouch. It was not justifiable to do more under ether than locate the œsophageal opening and to find its size. The attempt to pass a bougie would probably have resulted in a fatality because the operator could not tell where the far end of the bougie was going. Under the fluoroscope however a small bougie with a small flexible spiral wire under ending in a small olive was inserted in the strictured œsophagus making a small gain each time. This was always done under the guidance of the fluoroscope. It is a nerve wracking and dangerous performance. In both of these patients the bougie finally picked its way into the stomach and then the swallowing of a thread was successful. Both patients were being fed through a gastrostomy fistula. Following the successful introduction of the thread retrograde bougienage was carried out. At the present time a No. 30 bougie passes in one case and a No. 28 in the other.

#### SUMMARY

In addition to the old finding that fibrosis of the œsophagus especially of the terminal portion is the result of infection from contiguous organs it has been shown that fibrosis of isolated areas is fairly common especially in such chronic infections as arterio-sclerosis. In infections of the blood stream the œsophagus is often involved to the extent of ulceration. In acute infections (pneumonia) the œsophagus may be infected. Chronic infection as shown by an infiltration of lymphocytes under the epithelium and in the glands and about the gland ducts is also common. Dilatation of the subepithelial blood vessels is an almost invariable finding in diseases such as cirrhosis of the liver which impede the venous circulation. I have stated in previous papers that cirrhosis of the liver and infection of the gall bladder are among the chief causes of infection of the œsophagus. As autopsy specimens of these conditions accumulate this fact is becoming more and more evident. Hemorrhage into the muscular layers extensive enough to disrupt them may occur when there is back pressure on the œsophageal ves-

## ESOPHAGEAL SURGERY

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From the Surgical Service of the Massachusetts General Hospital

The glands of the esophagus are especially liable to infection, and are probably the chief route by which the esophagus is infected from within. One form of solitary follicle is simply a collection of lymphocytes following a gland duct to the surface. To recapitulate, the esophagus can be infected from within for structures or fibrosis to occur in any part of this organ.

## SURGEONS

are fond of referring to the esophagus as one of the "last frontiers of surgery," and are apt to imply that its conquest and development lie "just around the corner." Our profession does not retire from marginal lands as easily as the political economists do, or the quest would have been abandoned long ago. Fortunately we have yielded a 99 year lease on the "fishing," and "flim," rights in this territory to an energetic group of specialists, and as the previous papers attest, the fishing has been good. The surgeon who professes any interest in the furtherment of knowledge concerning diseases of the esophagus should either "fish or cut bait" so let us "cut bait" for a few moments and review the results of a limited personal experience in this difficult field.

## CARCINOMA

The challenge of malignant disease has been second only to the exigency of wounds of battle in leading the surgeon to extend the boundaries of his science. Nearly every surgeon of experience has considered the problem of carcinoma of the esophagus and many have tried out their ideas at the operating table or in the experimental laboratory. It is needless to recount the successes—they are so few that they are known by name as "Torre's case," or "Egger's case." The most recent is "Turner's case" (8) I shall briefly state my own disappointing experience with the operative treatment of carcinoma of the esophagus.

Two patients with hypopharyngeal carcinoma (Torre's female type) have been operated upon by the lateral approach and the esophagus reconstructed by a skin flap after the method of Trotter. In both instances the continuity was re-established, as evidenced by healed. Following the operation neither patient could swallow anything except small amounts of liquid, due to the destruction of the muscles at the pharyngo-esophageal junction that play so important a rôle in the mechanism of swallowing. One patient died of recurrence in less than a year, and the other is now in a terminal stage with cervical lymph node involvement. Although the exposure seemed adequate at the time it is probable that the transthyroid approach described by Otton may be more satisfactory. The failure of the patients to regain the function of swallowing after such an elaborate plastic procedure is disheartening.

The tumors of the middle third of the esophagus that I have explored have invariably proved inoperable.

In my opinion, tumors of the lower third of the esophagus, other things being equal, offer the best opportunity for successful radical surgery. Again, several have been explored and found inoperable. In two instances, however, the procedure described by Sauerbruch was found thoroughly practical. Nevertheless, both patients died of metastasis, one on the tenth day and the other on the second. This operation entails an

Presented in the Symposium on "The Esophagus" before the Clinical Congress of the American College of Surgeons, Boston, October 15-19, 1934.

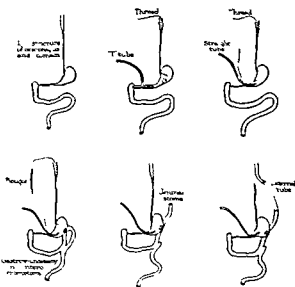


Fig. 1. Successive steps in the treatment of a severe lye burn of the esophagus and stomach.

extrapleural approach with the stripping of the diaphragmatic pleura from the muscular layer of that organ. After exposure and mobilization of the growth the diaphragm is cut radially to the oesophageal hiatus and the stomach drawn upward into the retropleural space. After the oesophagus is severed at the cardiac orifice and the stomach is closed the segment of the oesophagus containing the growth is devitalized by a crushing clamp and tight ligature and implanted in the stomach by a modified Witzel procedure. The bulbous growth placed in the lumen of the stomach serves temporarily to ease any undue tension on the suture line and is ultimately digested by the stomach juices. While the operation appears to be a practical one and the exposure excellent and not overly difficult the operation is probably too extensive when carried out as a single stage procedure.

Patients with carcinoma at the lower end of the oesophagus should almost invariably be subjected first to a laparotomy, since not infrequently the growth involves the cardiac end of the stomach, the adjacent lymph nodes and frequently the liver. At this stage a gastrostomy may be performed if the growth is inoperable. I would propose therefore, that a laparotomy precede the operation described above and if no intra abdominal extension of

the disease is found, that the cardiac end of the stomach be mobilized by cutting the left gastric artery, and the gastrohepatic omentum—a maneuver that is difficult from the retropleural approach. A jejunostomy rather than a gastrostomy may then be performed and the remainder of the operation described above be carried out at a second stage.

As an alternative we must consider in this type of growth the "pull through" method that has now been successfully performed by Mr. Grey Turner (8). It carries the disadvantage of requiring the construction of a subcutaneous oesophagus but may very well prove to have advantages that outweigh this factor.

#### STRICTURES

The construction of a new oesophagus from the skin of the thorax by the method of Rovsing (5) is a surgical feat that will almost certainly have increasing use in the future. It has been described chiefly in connection with impassable lye strictures but also finds application following resection of the oesophagus for carcinoma. Although I have not had the opportunity to complete this operation the following case history shows the circumstances under which it may be applicable. It also illustrates the complications that may result from extensive chemical injury to the stomach and a method of operative relief.

CASE 1. L.G. (Fig. 1). On October 10, 1931, a housewife aged 31 years, accidentally swallowed a cup of lye solution. Three weeks later she was referred to the Eye and Ear Infirmary at which time she was able to take only small amounts of water and milk by mouth. Under observation she showed a rapid and progressive loss of weight and developed neurological symptoms attributable to deficient diet.

On November 21 oesophago-copv was performed by Dr. Tobey. The mouth of the oesophagus was found closed by fresh fibrous adhesions preventing the passage of the oesophagoscope. The smallest oesophageal bougie (No. 15) could not be passed.

On December 10 laparotomy was performed with the intention of establishing a gastrostomy. The stomach was found to be small, oedematous and adherent to the pancreas. The thickening and induration of the stomach extended downward from the cardiac orifice and included the pylorus and the first portion of the duodenum. There were many fresh adhesions from a perigastric inflammation. An incision was made into the stomach just above the pylorus and the wall was found to be 1 centimeter in

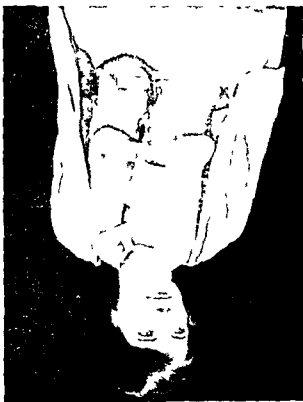


Fig. 2 Patient with external (rubber) esophagus

at a level of 2 inches below the upper border of the sternum and the lower end of the upper portion brought out to form an artificial stoma in the neck, as the first step toward the reconstruction of an external esophagus. This upper portion of the esophagus was then dilated by retrograde bougienage to accommodate a No. 32 French bougie. The patient was again discharged from the hospital returning on January 6, 1933. At this time a laparotomy was performed and the loops of the gastrojejunostomy identified. One limb of the jejunum was severed just above the entire enterostomy and its free end carried externally through a skin tunnel to a level above the nipple. The bowel sloughed to the level of the costal arch but at that point a good jejunal stoma was established. The cervical esophagus was then connected to the jejunal stoma with a large, soft, rubber tube (Fig. 2) and by March, 1933, the patient was able to eat without difficulty a liberal solid diet. The gastrostomy tube was still kept in place. The patient refused further operative procedure at this point because of her dissatisfaction with the external rubber esophagus and she was discharged from the hospital with advice to return for observation and the construction of a skin tunnel esophagus. Although attempts were made to keep track of the patient through the district nursing association no further co-operation was obtained from the patient or her family. Her alcoholic habits were resumed and she was ultimately taken to a local hospital in a semicomatose condition and died. At least she had the satisfaction of drinking herself to death.

thickness. The layers of the gastric wall could not be identified. The stomach itself contained brown, foul smelling fluid similar to that which the patient had been expectorating. A No. 24 T-tube was inserted, one end extending upward to the cardia and the other through the pylorus into the duodenum. After a very stormy course the manual symptoms arising from the deficient diet subsided and the patient's condition improved. X-ray studies on December 30 showed almost complete obliteration of the esophagus below the larynx, a small area of intact stomach at the cardiac end, and a free flow of barium into the duodenum through the T-tube. On January 19 the patient was able to swallow 3 jabs of silk thread. This could not be recovered through the T-tube so the tube was removed bringing the end of the thread with it. An attempt was made to reinsert a catheter into the duodenum under the guidance of the fluoroscope but was unsuccessful. On February 9 a No. 18 French bougie was passed through the gastrostomy opening to the mouth. Increasing difficulty was found in retaining the gastrostomy feedings and the capacity of the stomach seemed to be not over 3 ounces. During the next 2 weeks the patient lost ground steadily, apparently due to increasing pyloric obstruction. On March 3, laparotomy was performed and a small pouch of stomach at the extreme cardiac end was dissected from the diaphragm and the left lobe of the liver. Its capacity was probably not over 3 ounces. An antecolic and antipyloric gastrojejunostomy was performed without clamps. When the stomach was opened it was not possible to identify any outlet toward the pylorus, as this end of the stomach had contracted to the size of a No. 22 catheter entering through the previously made gastrostomy opening. An enteric enterostomy between the 2 loops of the jejunum was also established. Feeding was continued through the gastrostomy opening and in 2 weeks bougienage was again instituted. The patient was then discharged to the Lye and Lar Infirmary for repeated dilations of the esophagus. The dilations were quite painful but a No. 20 French bougie was passed at weekly intervals. In July, 1932, the patient was readmitted to the hospital for severe stomatitis. At this time the patient could swallow some milk but was depending for the most part upon the gastrostomy tube for feeding. In September she was readmitted to the hospital, still depending upon her gastrostomy feeding. Her general condition was much improved although the anemia had increased somewhat. On September 20 esophagoscopy was performed by Dr. Campbell Smyth who reported a stricture 6 inches from the upper teeth that accommodated only a No. 15 Nitroform bougie. On October 13, under local anesthesia the esophagus was exposed in the neck. It was found to be thickened and indurated. It was completely severed

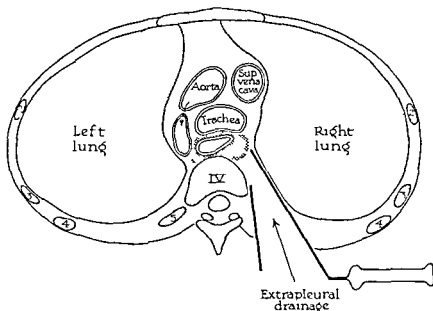


Fig 3 Cross section at level of fourth dorsal vertebra showing extrapleural route to mediastinum

#### MEDIASTINITIS

Acute infection arising from perforation of the œsophagus may follow the trauma of a foreign body or result directly from instrumentation. The characteristically virulent and fatal course is well known and in fact is one of the chief hazards of any procedure that involves the surgical manipulation of this organ. The division into two stages of the relatively simple operation for pharyngo-œsophageal diverticulum is a surgical expedient designed to obviate infection.

Pearse has described a method for the immediate handling of perforations of the cervical œsophagus that appears sound if the accident is recognized within a few hours. Frequently however perforation by an instrument is not recognized until mediastinal infection has already taken place, or indeed the peri-œsophageal infection may find origin in an abrasion of the wall of the œsophagus without actual perforation. If the infection remains localized drainage through the œsophagoscope may be adequate, but the diffuse mediastinal infections almost invariably prove fatal. In 2 such cases I have employed for the purpose of drainage a direct posterior approach to the mediastinum. As one patient

recovered it seems worth while to describe this procedure. It is quite possible that a cervical drainage route could have been established with an equal degree of success but in the absence of signs of infection in the neck I feel that the posterior approach directly to the mediastinum gives more effective drainage.

CASE 2. M.B. a school teacher, aged 60 years was subjected to œsophagoscopy on February 18 1932 for dysphagia. A spur was found on the anterior surface of the sixth and seventh cervical vertebra pushing the œsophageal wall forward and causing partial stenosis. Orthopedic treatment for her spine was carried out but the dysphagia persisted.

On June 11 1932 another œsophagoscopy was performed and during the course of the examination spontaneous emphysema developed extending upward from the neck to the eyes. The patient's temperature that evening was 103 degrees and she complained bitterly of pain in the chest. The following day she began to raise foul, thin, purulent material and although the emphysema was less marked her temperature remained elevated. In the period between June 13 and 20 the raising of foul, thin purulent material continued and she was kept in the Trendelenburg position and given repeated injections of intravenous glucose.

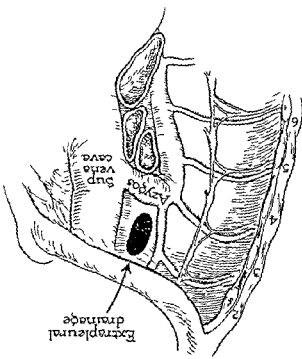
On June 20 another œsophagoscopy showed definite perforation of the wall of the œsophagus with pus draining into it. The patient's general condition was still alarming with a high fever, rapid pulse, and increasing weakness. X-ray examination

showed widening of the mediastinum and haziness of the lung fields. There was no tenderness or other sign of infection in the cervical region.

On June 29 under avertin anesthesia an incision was made close to the spine over the upper portion of the chest and the lower portion of the trapezoid and rhomboids were severed. The third, fourth, and fifth ribs were resected from the transverse process of the vertebrae to their angles and the transverse processes shortened. By vertical dissection the thickened and inflamed parietal pleura was separated from the lateral aspect of the vertebrae and the dissection carried forward until the lateral aspect of the posterior mediastinum was exposed (Fig 3). An aspirating needle was inserted into the mediastinum and foul air with a small amount of pus obtained. Continued aspiration during the withdrawal of the needle yielded a free flow of blood, showing that the needle had passed through the azygos vein into the mediastinum. About 2 centimeters cephalad to this point there was an area of the mediastinum that fluctuated with respiration (Fig 4). An aspiration here immediately entered the mediastinum. A window approximately  $1\frac{1}{2}$  centimeters in diameter was made at this point and foul necrotic slough with blood stained pus obtained. The exploring finger entered between the esophagus and the vertebral column. A very soft rubber tube was sutured to the walls of the opening into the mediastinum but was not inserted into the abscess cavity for fear of further erosion of the esophagus. The incision was packed with gauze. The patient ran a febrile course for 21 days, then her temperature became normal and she was discharged from the hospital on the forty fourth day. A small sinus persisted for some weeks but ultimately closed and the subsequent course of the convalescence has been uneventful.

Case 3. J. C., an American woman, aged 51 years, entered the Lye and Ear Infirmary on March 3, 1933 complaining of difficulty in swallowing of 2 weeks' duration. Esophagoscopy was performed and an annular obstruction found  $1\frac{1}{2}$  inches from the upper teeth. A small amount of blood was encountered and no specimen was removed. Following the esophagoscopy the patient complained of constant substernal pain. There was also marked pain on swallowing. Subcutaneous emphysema was observed in the soft tissues of the neck and upper mediastinum by X ray. Her temperature ranged from 102 to 103 degrees with a rapidly increasing pulse and a discharge of foul pus by mouth. There was no sign of infection in the cervical region and as the patient's condition was rapidly becoming more desperate the operation described above was performed on March 17. This was encountered above the level of the azygos vein and an opening approximately 1 inch in diameter was made into the mediastinum and two large pieces of necrotic sloughing tissue picked out. The patient's condition rapidly became worse and she died 12 hours following the operation.

Fig 4 Diagram showing site for entering mediastinum just above the arch of the azygos vein



An autopsy revealed perforation of the esophagus, phlegmonous esophagitis, with ulceration of the mucosa, gangrenous mediastinitis, bilateral bronchopneumonia and a carcinoma of the stomach.

# CARDIOSPASM

Although the usual case of cardiospasm may be treated successfully by dilatation, need for more radical measures will be encountered from time to time. The development of surgical methods to meet these circumstances has been reviewed by Professor Bull of Oslo and by Mr George Grey Turner (9), now of London, so my remarks will be limited to the reporting of 2 personal cases.

Case 1. A. B., a housewife of 44 years, was first examined in the Eye and Ear Infirmary on April 30, 1930. At that time she gave a history of cardiospasm dating back to a fall 11 years previously. At this time a therapeutic abortion was performed. A year after the hysterectomy the patient noticed her first difficulty in swallowing, associated frequently with vomiting. She described the food as almost forming a distressing lump for which relief was found reaching the stomach and then being held up and regurgitated. She had been able to swallow only liquids and semisolids. Some solid food was "washed" by the obstruction with the aid of water. She had at times vomited food that was 3 days old and had a foul odor. Three years before admission a period

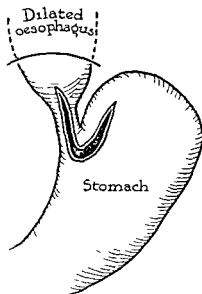


Fig. 5. Incision for œsophagogastric anastomosis

of complete inability to swallow food was relieved by a gastrostomy. This was utilized for a 6 months period and then allowed to close. Her weight during the 3 years previous to admission fell from 150 to 90 pounds.

At the Eve and Ear Infirmary a Mosher bag was passed twice with some improvement. Fluoroscopy showed dilatation of the œsophagus with retention of barium. She was treated by repeated dilatations over a period of 6 months. In June 1931 she reported a further loss of 22 pounds. Later in August she reported that she was eating only liquid foods.

In October 1931 œsophagoscopy showed filling of the œsophagus just above the cardia but no evidence of ulceration or malignant disease. On November 16 1931 a gastrostomy was performed the patient weighing only 91 pounds at this time. A high caloric vitamin rich diet was given through the gastrostomy tube and she was discharged to continue this regime under the guidance of her own physician. She was readmitted to the hospital January 21 1932, having gained over 7 pounds in the interval. Fluoroscopic examination showed a fluid level in the œsophagus at the level of the arch of the aorta. The barium meal revealed a dilated œsophagus with the usual tapering lower end and complete retention of the barium in the œsophagus.

On January 28 1932 following a crushing of the left phrenic nerve an incision was made from the costoxiphoid angle to below the umbilicus. The gastrostomy incision was walled off by sterile drapings and not disturbed. Because of the narrow costal arch the ninth and tenth ribs were sectioned subperiosteally through a second incision in the mammary line. This gave an ample exposure al-

lowing mobilization of the left lobe of the liver (2). The œsophagus was freed from the hiatus of the diaphragm and pulled down until its dilated portion was exposed. It was then united to the stomach and a U shaped incision was made with one limb extending to the dilated portion of the œsophagus and the other extending along the cardiac end of the stomach (Fig. 5). On opening the œsophagus there was no evidence of ulceration or peri œsophageal inflammatory tissue but there seemed to be some thickening and fibrosis in the muscular layer of the œsophagus. The anastomosis was completed as in a Finney pyloroplasty and the line of suture enforced with omentum. Following the operation the patient was fed through a gastrostomy tube and her convalescence was uneventful.

On February 15 1932 she enjoyed a meal of eggs potato and toast by mouth and was discharged from the hospital on a 6 meal bland diet.

In October, 1933, she was eating everything by mouth except very heavy meats and doing all of her housework. The gastrostomy had been closed for some time. Fluoroscopy showed some delay at the cardia but a steady stream of barium entered the stomach. The patient had gained weight and was greatly pleased by the improvement following operation.

CASE 5. F.P. an American housewife aged 35 years was seen in April 1932 complaining of substantial discomfort and epigastric pain of 8 months' duration. There was no real dysphagia at the outset but regurgitation of liquids occurred when they were rapidly ingested. A month after the first symptoms, attacks of severe epigastric pain appeared which were relieved by food or soda. These had increased in frequency and showed but slight improvement from dietary treatment. X ray examination 3 months before admission showed a slightly dilated œsophagus with retention of barium.

œsophagoscopy on May 5 1932 showed slight thickening in the wall of the œsophagus near the cardia. The mucous membrane was intact. There was no evidence of ulceration and a definite diagnosis was impossible, although carcinoma was seriously considered. The patient was placed on a 4 meal bland diet but continued to lose weight and suffered from regurgitation. Tincture of belladonna and nitroglycerin medication gave some relief but a second X ray examination in September 1932, showed the same type of deformity in the œsophagus.

The patient was admitted to the hospital a second time in October 1932 the epigastric pain being less frequent but the regurgitation worse. She was kept on the wards for over a month gained weight but still complained of regurgitation and difficulty in swallowing. Treatment with the Hurst bougies was instituted while in the hospital and she was discharged under supervision to continue bougienage. Her general condition remained stationary but the continued pain which occurred particularly after passing the bougie led to its discontinuation because of the possibility of traumatizing an ulcer. X ray



## SUMMARY

Illustrative cases from a limited experience in the surgery of the oesophagus are presented with comments  
The history of a case of impassable stricture is reviewed with special reference to the handling of the chemical injury to the stomach  
Posterior extrapleural drainage is advocated for mediastinal abscess following perforation of the oesophagus and a successful case noted  
Intractable cases of oesophagitis may be relieved by oesophagostomy anastomosis, as illustrated by 2 case records

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examination in October, 1933, showed a constriction of the lower end of the oesophagus with marked retraction and increasing dilatation

The woman was again admitted to the hospital on October 19, 1933, and placed on a high caloric, high vitamin diet. She was able to take 8 ounces of liquid food every 2 hours so gastrostomy was not performed. Because of the severe pain accompanying the use of the bougie in this patient it was decided to do a gastro oesophageal cardioplasty

On November 22, 1933, the phrenic nerve was crushed in the neck and the left lobe of the liver mobilized through a right rectus incision. The lower end of the oesophagus was mobilized to expose the beginning of the dilated area. No per oesophageal inflammation, oedema or scarring was disclosed. The lower end of the oesophagus was sutured to the stomach with silk and the opening into the mediastinum closed to prevent contamination. A U shaped incision was then made, with one limb extending out of the cardiac end of the stomach and the other running up the oesophagus to the dilated area. Anastomosis was completed as in a Finney pyloroplasty and the left lobe of the liver resuspended. Her ability to swallow improved immediately after the operation and although postoperative X rays showed the same dilatation of the oesophagus the barium passed course the patient maintained the improvement, although occasionally regurgitation occurs, particularly at times of mental strain

Dr Chester Jones who has followed the patient as medical consultant, considers her status 1 year after the operation to show 75 per cent improvement. Present X ray films show very little delay in the passage of barium from the oesophagus into the stomach

We may conclude, therefore, on the basis of these 2 cases and from the more extensive experience of others, that surgical measures and a definite, even if limited, use in the direct treatment of cardiospasm

## EDITORIALS

### SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY 15 1935

### THE 1934 CLINICAL CONGRESS IN BOSTON

THAT American surgeons are seriously interested in improving their minds and exchanging with their colleagues knowledge they have found valuable in the management of surgical relief was evidenced to a superlative degree during our most recent clinical meeting. Through the combined efforts of the central and local committees on arrangements every possible clinical facility in greater Boston was made available to the visiting fellows. A wide variety of general and special work was demonstrated. Many extra features absorbed the unexpectedly large attendance in such an interesting manner that it is difficult to believe that any visitor failed to carry away some helpful suggestion. There was a spirit of willingness and co-operation demonstrated among the teachers in our medical schools and hospitals that would be hard to equal. That the meeting was a success is evidenced by the general feeling among the visiting Fellows and by the numerous expressions of their gratitude. Those who participated in the program were

enthusiastic regarding the high grade of intelligence, the eager and attentive attitude of those who filled the amphitheatres in every hospital and in nearly every clinic or demonstration. Their feeling was one of general satisfaction that their efforts were appreciated.

The scientific sessions were attended to the capacity of the auditorium. Subjects of general interest were presented by authorities from this country and abroad in a manner that held these audiences until late in the evening. Conspicuous among these speakers were the younger full time professors of surgery from our American medical schools. Some of our distinguished foreign guests participated in these programs in a most charming and effective manner. New and important advances in surgery were presented and discussed without doubt carrying far reaching benefit throughout our nation.

Boston was honored by the central committee in that the outstanding researches of Prof. Harns P. Mosher of Harvard Medical School were recognized by an afternoon symposium on "Diseases of the Esophagus", usually local authorities are not permitted to present their work at the scientific sessions.

In addition to the operative and dry clinics in the larger hospitals of Boston, which are always crowded, the splendid suburban hospitals were well attended. To these more distant clinics transportation was provided by the hospital, and if the session occupied the entire day, luncheon was served. That these efforts were of great value and appreciated, there can be no doubt.

The special hospital conferences were of interest as usual, and the attendance was

available was the gallery of the Statler Hotel ballroom. In spite of the inaccessibility of this arrangement, it was found that many were interested and spent much time in this department.

A new feature sponsored by Dr Shields Warren was the demonstration of fresh pathological specimens from the operative clinics each day. These were brought together and discussed by our eminent pathologists. The specimens were shown on the screen by means of the Zeiss episcopes, and were of natural color and without distortion. It was possible for one to see in this manner the specimen he had seen removed that morning in the operative clinics.

At the Boston Medical Library much interest was exhibited in the historical pageant sponsored by Dr Spector and given by the students of Tufts Medical School. Dr F B Lund gave a charming and interesting illustrated lecture on the surgery of ancient Greece. Here also were exhibited the artistic hobbies of the Boston profession. Many of the fellows enjoyed this pleasing feature.

The Presidential Meeting on Monday evening and the Convocation on Friday evening at Symphony Hall were impressive as usual. The addresses of Dr Haggard and Dr Greenough, the Murphy Oration by Dr Lotus D Coffman were all thoroughly enjoyed. The high grade of the candidates accepted was gratifying. It is felt that Boston may be proud to have acted as host during a Clinical Congress so obviously successful.

ARTHUR W ALLEN

Other special conferences, on cancer, fractures, industrial medicine, and traumatic surgery, were well attended. These special features of the work of the College are obviously of such importance that a continuation of such activities is necessary.

The clinics of the eye, ear, nose and throat sections were all overcrowded. Their scientific sessions were held in a special auditorium admirably suited to their needs. Many distinguished guests participated in their program, all to the advantage of those fellows interested in these specialties.

The community health meeting on Wednesday evening at the Arena was a revelation to greater Boston. There was considerable doubt in the minds of the local committee whether this great auditorium would be filled. The program was of such character, however, as to attract a capacity audience. More than 10,000 of our citizens were sufficiently interested in their health to attend. Actually some 2000 who sought admission were unable to find seats. That this will be of widespread benefit in our community is certain. Enthusiastic reports continue to come in.

The motion picture exhibitions were excellent. Many new films of approved surgical procedures were included this year. One found a continuous stream of visiting fellows slipping in and out of this projection room. This graphic method of teaching standard methods for specific problems in surgery is of utmost value.

An attempt was made to display a limited number of scientific exhibits. These were mainly by local contributors. The only space

# PRESIDENTIAL MEETING, CONVOCAATION

## ADDRESS OF WELCOME<sup>1</sup>

ARTHUR W. ALLEN, M.D., F.A.C.S., BOSTON, MASSACHUSETTS

ON behalf of the local Committee on Arrangements it is my pleasant privilege to bid you welcome. It is particularly fitting that this Twenty-fourth Annual Meeting should be held here as your President elect, Dr. Robert B. Greenough, so admirably typifies Boston surgery. His untiring efforts in the advancement of education and service to humanity make it assured that your institution will thrive under his leadership. Boston has always stood for a high standard of education. This has been true in medicine and surgery and community service. Our predecessors have made great contributions to science. Among them are the Warrens, Oliver, Wendell Holmes, Bigelow, Cabot, Richardson, Fitz-Miller, Homans, Cheever, and the Porters. Some of these have left sons, but all have left disciples to carry on the torch of learning, teaching, and service to mankind.

It has been six years since the Clinical Congress of the American College of Surgeons visited our city. During this interval there has been a considerable increase in our clinical facilities. New hospital buildings have been erected and modern equipment installed. The standard of service has kept pace with these improvements. It seems fitting to mention particularly the excellent hospitals and high grade of work now found in our

suburban communities. We wish it were possible for each of you to visit these splendid clinics and many of you will have this opportunity.

The medical schools and hospitals of greater Boston have seriously attempted to utilize every available facility to make your stay with us worth while. We realize that all of you will not be able to gain admission to each feature of the program that you may select. Let us urge you to accept with good grace some alternative clinic or demonstration for an effort has been made by the combined local and central committees to offer you nothing that will fail to be of interest.

At the medical library there will be an opportunity to see interesting features pertaining to the history of our science. Also, here will be displayed works of art as an illustration of a pleasing hobby by members of our local profession. Numerous other entertaining and instructive possibilities have been made available.

To those of you who are honoring us by your first visit, let us remind you of the many points of historic interest in and about this old City of Boston. You may become lost in the maze of our crooked streets but you will find our citizens courteous and helpful. It is our earnest desire that your stay with us be pleasant, interesting, and beneficial.

<sup>1</sup>Presented before the Clinical Congress of the American College of Surgeons, Boston, October 25, 1934.

THE BACKGROUND OF THE AMERICAN SURGEON<sup>1</sup>

WILLIAM D HAGGARD, M.D., F.A.C.S., D.C.L., NEWBURY, NEWYORK

In their life and doctrine, they (our forebears) set forth a true and lively word to the great enlightening of our darkness.—OWEN.

Gigantic daughter of the West,  
We drank to thee across the flood  
For art not thou of English blood?

American civil polity and supremacy among the powers is the marvel of mankind. What is deomonated Americanism is the same spirit which finally subdued imperial Rome after four years, which stopped the hordes at Exeter, rolled back the tide of Asiatic invasion beyond the Pyrenees, and preserved civilization from oriental degradation. Americanism incarnate gave the idealism for right against might in the World War and preserved by blood and treasure the allied nations

In the earlier days our civilization "was nursed by strong men with empires in their brains." The first American surgeon of whom we hear was the sterling John Jones, who with Hunter studied under Percival Pott, fought in the Colonial and French wars, was the first teacher of surgery in King's College in 1767, and the first in America to perform lithotomy.

William Shippen, Jr., of Philadelphia, physician-general to Washington's armies, special pupil of William Hunter, was professor of surgery in the University of Pennsylvania, which he helped found in 1765. Shippen with Jones of New York and Warren of Boston—the triumvirate of early pioneer surgeons living in the three large cities—disseminated their teachings throughout the 13 states. The fertile soil of America has produced patriots, poets, scholars, and inventors but none has contributed more for human weal and happiness than the surgeon. In the first quarter of the eighteenth century, a writer in the *Edinburgh Review* asked, "What does the world yet owe to American physicians and surgeons?" Suppose that question were asked now. What would history answer?

A brief epitome of the historical drama of American surgical achievements, like a trans continental airplane, looks upon the high peaks only among into some of the treasures of biography. The Warren dynasty of 5 generations gave to Boston historic and epochal events in the march of American surgery. John Warren founded the Harvard Medical School in 1752.

He built beyond mortal thought—  
Far in the Unapparent

Is disciples  
A noble heritage. Its disciples  
great minds who have glorified time. There  
has been an apostolic succession in surgery from  
the Father of Medicine to each Bishop in our  
Presbyhood to the latest devotee who enters the  
sacred portals. Galen, Avicenna, de Chauliac,  
Pare, Harvey, and Vesalian who was a bridge  
of one plank from the seventeenth century to  
Chesedown, down to the immortal Lister who  
gave "a new Heaven to medicine and a new  
Earth to surgery." His carbolic dressings due to  
Faster were more potent than the sweet smell-  
ing spices that Rebecca poured upon the wounds  
of Jacob.

The background and tradition of the surgeons  
of the New World are predominantly British.  
Before the arrogant George III lost the American  
colonies, the best medical men in the new country  
were graduates of the University of Edinburgh,  
'Scots' darling seat.' There surgery was in full  
bloom. Munro I, II, and III and their colleagues  
flourished. The bells were great ornaments in  
London there were Parry, Cullen, Abernethy,  
"the five custodians of the Gold Headed Cane,"  
and the immortal Jenner, friend of John Hunter  
and godfather to his son. When 'the Great Surgeon' was spoken of in the days of Macaulay, the  
people thought of Brodie, as when they said "the  
Duke" it meant Wellington. There were also in  
that great constellation, Colles, Ferguson, Erich-  
sen, to whom Lister was house-surgeon, Simpson,  
and Paget. Some of these reached the empty realm,  
and to use Shelley's words, "robed in dazzling  
immortality, sit on thrones."

John Hunter, next to Hippocrates, in the opinion of Gross, was the greatest figure in the history of medicine and the most remarkable observer of nature since Aristotle. Hunter, that lordly soul, raised surgery from the crude and simpler procedures to the dignity and responsibility of a true science. He created a unity between physiology and pathology and linked them with the natural sciences. A brilliant number of ambitious American medical students brought back Hunter's methods and those of the great contemporary teachers and from them has developed the flowering splendor of the surgery of America, that country apostrophized by Tennyson as the—

When the Charlestown ferry to Cambridge was stopped by ice he went round by Roxbury, performed his own dissections and lectured 3 hours. While Napoleon was divorcing Josephine, the Harvard Medical School was divorced from Cambridge. John Warren's older brother, Dr. Joseph Warren, was killed at Bunker Hill. Warren later crowned that acropolis with sublimity at the time Monroe was enunciating his doctrine.

John Collins Warren studied with Sir Astley Cooper. Cooper was trained by Henry Cline, who tapped the enormous hydrocele of Gibbon and withdrew 6 quarts of fluid. Warren was a dresser at Guy's Hospital for which privilege he paid two hundred and fifty dollars a year. John Keats was also a pupil at Guy's with American students in 1817. He abandoned medicine and in a year his imperishable 'Endymion' shot through the heavens like a meteor. After graduating at Edinburgh, Warren lived in Paris with Napoleon's surgeon, Du Bois. He, with James Jackson, established the great Massachusetts General Hospital 113 years ago. There was destined to be enacted the great drama of anesthesia, 'the death of pain. It was joyful news out of the new found world.' The eighty eighth anniversary of Ether Day will be celebrated tomorrow because a Warren dared to employ ether, while William T. G. Morton hopefully administered it. Warren risked his unrivaled reputation to say nothing of the life of his patient in this most sublime experiment. He was a great teacher—the surgical autocrat of New England—and dominated the Hunterian era. The first operation in America for strangulated hernia Warren did. He introduced staphylopharynx. He did amputations and cauterized operations with great celerity. Longfellow, his patient, said that he had the eye of an eagle and a woman's hand.

Ether anesthesia, however, was first intentionally produced by the abolition of pain in a surgical operation by Crawford W. Long of Jefferson, Georgia, 'a spot in the wilderness of a new continent' in 1842. Long used ether in childbirth, delivered his wife under ether and performed one or more operations under its influence annually thereafter. Unfortunately, he did not publish his work until 1849.

Philip Syng Physick has been called the Father of American surgery and had a chair of surgery apart from anatomy created for him in the University of Pennsylvania in 1805. Through the influence of Hunter, he received his house surgery at St. George's hospital. "Physick was almost as much a mouthpiece of the doctrines of

John Hunter in America as was Abernethy in London." Both had many disciples but neither left a great successor. Physick paced the alleyways of Philadelphia for several years before he earned enough to powder his cue. Stephen Girard was his intimate friend and Benjamin Rush his closest associate. Physick was the first to do lateral anastomosis by compression of the two loops of the intestine for artificial anus following strangulated hernia, the principle in Mikulicz's operation as done today. He also removed a thousand calculi from the bladder of Chief Justice John Marshall. He invented the tonsillotomy. He wrote not at all. His students were his publishers. Physick first employed the absorbable ligature. He was the first to use the stomach pump for poison, the first to operate for imperforate anus. Physick lived in terror lest his body be dissected, whereas John Warren made a legacy in his will that his body should be dissected and his skeleton hung in the lecture room. Gross believed that Physick raised American surgery from its somewhat low state and so developed it that it soon became equal to the best surgery of Europe. Physick ignored the report of the first ovariectomy by the lion-hearted McDowell in 1809, but he was not ignored by the Goddess who emblazoned his name on the Roster of Immortals.

Nathan Smith, a frontiersman in surgery, performed an ovariectomy in Vermont in 1821, without the knowledge of McDowell's operation. He removed a 10 pound tumor and dropped the pedicle after tying it with a leather ligature. He founded Dartmouth Medical School in 1798, established the medical department of Yale College, New Haven, and filled the chair of surgery in 1813. Welch said of him that he did more for the general advancement of medical and surgical practice than any of his predecessors or contemporaries in this country.

"Premier surgeon of the West," Benjamin W. Dudley of Lexington, Kentucky, after graduation at the University of Pennsylvania, studied abroad. The money for his European education was obtained by taking a flat boat of produce to New Orleans, exchanging it for flour, transporting it to Lisbon where he sold it for enough for a 4 years course in London and Paris. He did 225 lithotomies with 222 recoveries. He was the first to ligate the subclavian artery for an aneurysm, (larger than a quart pitcher), in 1825. His success was largely due to the use of boiled water and the boiling of his instruments. In 1818, he challenged Daniel Drake, the great man of the West, to a duel which was declined, and his friend, Dr. Richardson, who took it up, was shot in the groin.

took the torch. Laennec and Trousseau occupied the teaching forum and had the world as an audience. France was the crucible of civilization. Science, art, and surgery vied with literature, drama, and vice.

Henry I. Bowditch studied under the great Louis White Trousseau and suggested thoracotomy and cannula and the technique in 1850, with Bowditch, who is said to have aspirated the chest after that some three hundred times without a fatality. The celebrated Dupuytren died of emphysema rather than submit to aspiration, saying that he had never known anything to succeed.

Henry J. Bigelow was one of the most brilliant of the products of the French school. A revered teacher, beginning in 1849 in Harvard, he discovered the iliofemoral (V) ligament of the hip joint. His greatest contribution was in lithotomy, by the perfection of the lithotrite. Stones crushed and removed by the evacuator at one sitting was a procedure perfected by him in 1878.

Samuel D. Gross was the most conspicuous surgeon of his day between the era of the French and German ascendancy. He was denominated "the master of American surgery", born in 1805, the year of Austerlitz and Trafalgar. Gross was an office student of George McClellan. He excised the trifacial nerve, invented the urethrotome, and perfected the treatment of stab wounds. His monumental treatise on surgery was begun while he was professor in Louisville. It was the first great American authority. When he spoke, 50 years of American surgery was speaking through his lips and he has been referred to superlatively as having earned the royal title of the emperor of American surgery.

The remarkable times in which the pioneers lived embodied them to perform operations that had never been done before. Abdominal section of the extra-uterine pregnancy was done by a bold surgeon in New York, John Bard, in 1759. It was not until 1894 that Lawson Tait did the first operation of the sort in England. William Baynham, of Virginia, performed the operation for extra-uterine pregnancy twice with success in 1799 in Essex County.

Dr. Jesse Bennett, in Virginia, did a cesarean section on his own wife in 1794. Cogswell was the first to ligate the primitive carotid successfully for primary hæmorrhage, in 1803. Walter Brashear of Bartonsville, Kentucky, did the first successful amputation of the hip joint, in 1806. Decardet, of Tennessee, removed a large part of the lower jaw, in 1810. Francis Fontaine Maury, a native of Kentucky, performed the first operation of gas-

but saved by the skill of Dudley who quickly ligated the femoral artery. He and Drake became fast friends and colleagues in Transylvania University, the first medical school west of the Alleghenies. Drake inaugurated most good and great things in Cincinnati, but that did not prevent Dudley from essaying to make a rent in the robe of Esculapian.

Valentine Mott, also a pupil of Asley Cooper, was the most famous of the New York surgeons. His contemporaries even regarded him as heroic in 1813, he excised the clavicle completely for osteosarcoma. It was the day before Waterloo when her beauty and her chivalry had gathered in Belgium's capital. Mott tied the primitive carotid 51 times and the femoral 57 times. The first ligation of the innominate artery he did in 1818. In 1826, he reported the first successful ligation of the common iliac artery. In all he performed 138 ligations. He lectured for 56 years continuously.

George McClellan founded Jefferson Medical College in 1825 and invented teaching by public clinics. He wore a swallow-tail coat and made his daily visits in a chaise. It was the year when Lafayette made his last triumphal tour to the United States. The son of George McClellan commanded mightily armies and stood upon the flaming brow of Malvern Hill. Brilliant, bold, confident operator, he was the first to excise the parotid gland.

J. Marion Sims, a South Carolinian, born near the native hearth of Andrew Jackson, did his memorable work in the cure of vesicovaginal fistula at Montgomery, Alabama, and made lateral anastomosis. He had operated upon the slave, Anarcha, twenty-nine times with twenty-nine partial or complete failures when, on that May day in 1849, he used the silver wire suture for the first time. It was an entire and complete success.

Sims established The Woman's Hospital in the state of New York in 1855, which was the fourth of gynæcology. He was succeeded by J. Addison Emmet, master gynecologist. Sims demonstrated his operation before Neaton, Denonville, and Velpeau. While living in Paris, he attended the Empress Eugénie at St. Cloud and was physician to the Duchess of Hamilton. A heroic statue of Sims stands facing the New York Academy of Medicine.

The lure of the Napoleonic era took many American students to Paris in the second third of the nineteenth century, it had supplanted Edinburgh as the popular mecca. The French

trotomy in this country. Kinloch, a Charlestonian, General Lee's staff surgeon, was the first to open the abdomen in case of gunshot wounds where there was no protrusion and sutured the perforations. William T. Bull has the distinction of first successfully opening the abdomen and suturing the perforations of a gunshot wound in 1885.

The first nephrectomy appears to have been performed by Wolcott in Milwaukee in 1861, 8 years before Simon performed the first case in Germany.

Dr. John S. Bobbs of Indianapolis did the first operation on the gall bladder from which a number of gall stones were removed. The patient recovered and was taken to the Portland meeting of the American Medical Association in 1902 where some of you may have seen her as did the speaker. The first splenectomy was done by Dorsey in Piqua, Ohio, in about 1835.

The first hysterectomy for a fibroid tumor of the uterus was performed by Walter Burnham of Lowell in 1853.

Hunter McGuire, one of the most distinguished teachers of surgeons in the South, was Stonewall Jackson's surgeon. He was the first to tie the aorta after Sir Astley Cooper (1868).

New Orleans furnished a brilliant group. To Warren Stone is ascribed the first resection of the rib for drainage in empyema and abscess of the liver. T. G. Richardson was the first surgeon to do a bilateral amputation of the hip joint at the same sitting in 1843.

Smith was the first to cure an aneurism by ligature of the innominate artery, in 1864. Mott's first case in 1818 was unsuccessful. Miles and Parham flourished and were succeeded by the surgical scholar and seer of America, the full-orbed star of the Crescent City.

Louisville produced Vandell the scholar, and Matthews the courtly surgeon. McMurtry was the cavalier and apostle of the new abdominal surgery.

Nashville was graced by Eve, surgeon in four wars who taught surgery to 454 students in 1839, the largest medical class ever gathered together outside of Philadelphia, and Briggs, also a lithotomist, both presidents of the American Medical Association. Haggard, who with W. E. B. Davis of Birmingham founded the Southern Surgical Association in 1888, and the brilliant Douglas.

In California Henry Gibbons gave the first course of medical lectures on the Pacific Coast in 1850, and his first patient was said to have dropped an ounce of gold dust on his desk (value of \$16) as his fee. The other great pioneer sur-

geons of San Francisco were Gibbons, Cooper, Toland, Lane, and Goodfellow, who was the exponent of the earliest prostatectomy.

The Northwest found the elder Mayo laying the foundation of the greatest surgical development yet witnessed not only in America but in the entire surgical world.

About 1860, the hegira to Germany by American students began. Virchow, Traube, and Langenbeck were the tripod upon which pathology, medicine, and surgery rested. Langenbeck was the most dexterous surgeon of his day. It was said that a man who came to see him do an amputation, paused to take a pinch of snuff and when he had sneezed the operation was over. Efficiency and great devotion were inspired by the masters—Kocher, Trendelenburg, von Bergmann, Billroth and Mikulicz.

Keen was the first to bring back antiseptics to Philadelphia after his German tutelage. With his friend the gifted S. Weir Mitchell, he made studies abroad on gunshot wounds and nerve suture. He was one of the first teachers of pathological anatomy. His pen was as mighty as his scalpel. He was the Nestor of surgery in our time. Joseph Pancoast, to whom was referred the daughter of the Lord Chancellor of England by Sir William Fergusson as the greatest plastic surgeon in the world, antedated him. We see also in Philadelphia the flashing scalpel of Agnew, whose clinic is immortalized in one of the strongest paintings of modern times.

In Canada, surgery had an almost exclusive English background and produced such stalwarts as Shepherd, Armstrong, Starr, and the great universities at Montreal and Toronto.

In New York, in the latter half of the nineteenth century, were Van Buren, Buck, James R. Wood, Frank Hamilton, T. Gaillard Thomas, Sand, preceded by Willard Parker, who did much to familiarize the profession in 1867 with the wisdom of operating for appendiceal abscess. The metropolis has had in the last four decades a long list of surgeons of stellar brilliance—of these McCosh, Abbe, Gerster, Wyeth, Bryant, Dennis, Sumson, Weir Bull, and Peck have luster.

Charles McBurney and Reginald Fitz did their transcendent work in appendicitis, McBurney perfecting its operative treatment in 1889, after Fitz described its pathology a year before. They both passed into the Valhalla of surgeons in the same year—1913.

Philadelphia, the cradle of surgery, had, as its pride the Ashursts, White, Rodman, the matchless Deaver, and Da Costa—scholar, author, teacher—who said, "No one knows of the haunt



Fenger brought the new pathology to America carried on the shoulders of his ardent admirers—cured ankylosis, introduced the most compression of the lungs, and invented the most exquisite surgical device in the world—the Murphy—greatest of American surgical teachers—cured ankylosis, introduced the most compression of the lungs, and invented the most exquisite surgical device in the world—the Murphy button.

Ochsner, chief of staff of Parks and Senn, became one of the greatest surgeons in our time and had the largest individual private surgical clinic in America. His voluminous writings covered many subjects and covered them well. These are some of the great surgeons of the Western World. Many wore the splendid robes of fame, many "the muses decked with gifts of grace."

"This rich background is your precious professional heritage. Hold it to your heart and cherish it."

Not Mars his sword nor war's quick fire shall burn  
The living record of their memory.

"The pride we have is not chauvinistic. We hail the improvements of our art from any clime far from being self-satisfied in the plenitude of our science, it is the principle of our guild to acclaim any real contribution to science, whatever its country, in the effort to prevent disease and mitigate its blight. Surgery has made such vast conquests that we cease to wonder. Its benefactions make the angels rejoice."

Descartes said that if there is any possible way of increasing the wisdom and ability of mankind, it must be sought in medicine. What shall be said for that great multitude of American surgeons who did not teach or write? But die with all their music in them!

"They have lived to lessen the sorrow and assuage the anguish of mankind, for the surgeon is a gladiator of sunshine in the patient's dungeon, when the loved ones are wraped in black despair. What a rich inheritance to be a surgeon in America, my America!"

In the land of youth and freedom beyond the ocean bars,  
Where the air is full of sunshine, and the flag is full of stars.

thing anxieties, the deep disappointments, the baffling perplexities, the dread responsibilities, and the numerous self-reproaches of one who spends his life as an operating surgeon. His hand must be as light as a floating perfume, his eyes quick as a flashing sunbeam, his heart as broad as humanity, his soul as sweet as the waters of Lebanon."

Baltimore was first seen in the firmament by the light of William Gibson, who was a pupil of Sir Charles Bell and a friend of Byron, and who was wounded at Waterloo. He was the first to perform the operation of ligating the common iliac artery in the year of our last war with England. Baiting more's fame was enriched by William S. Halsted, founder of the Hopkins School of Surgery, who did great work in conduction anesthesia, carcinoma of the breast, goiter, hernia, and many other fields touched by his genius, which is never to be forgotten. This luminous figure, having no children of his own, was the prolific father of Surgeons.

Among Boston's great are remembered Cheever, Homans, Cabot, the Porters, Mixter, Munro, and the great hearted Laurence Richardson who taught the new abdominal surgery, and, as Almonford said of Oliver Wendell Holmes, sat for years amid the *Acadaphians* in the seat of honor.

In Cincinnati there was Connor, Dandridge, and Karsnoff, in the twin cities, Wheaton, Moore, and McLaren. When we think of Albany, we think of Van der Veer, of Buffalo, of Roswell Park, of San Francisco, Harry Sherman and Tom Huntington, of Richmond, George Ben Johnson, of St. Louis, McDowell, Pope, Hodgson—who devised the ingenious and useful suspension splint, of Texas, Thompson, and of the Pacific Northwest, the late lamented Coffey, who devised safe ureteral transplantation.

The radiant sun of modern surgery, that was to shine so effulgently over Chicago, had its dawning with the arrival of Daniel Bramard in shabby clothes on an Indian pony. He found not more than one hundred people around Fort Dearborn. In 1837, he took out a charter for the Rush Medical College and after a season of study in Europe, opened the College in 1843. Bramard's work was original on unmitigated fracture, the invention of the bone drill, and iodine injection for spinal abscess.

Moses Gunn, a luminary, was succeeded by Charles T. Parks, physically and mentally a gem. Edmund Andrews was the first to employ nitrous oxide in general surgery. The group that made Chicago famous as the clinical center of the West comprised Fenger, Senn, Murphy, and Ochsner.

EFFICIENT SURGICAL SERVICE FOR THE WHOLE COMMUNITY<sup>1</sup>

ROBERT B. GREENOUGH, M.D., F.A.C.S., BOSTON, MASSACHUSETTS

UNDER the broad charter of its articles of incorporation, the American College of Surgeons has brought about outstanding improvements in the practice of surgery in this country in the 22 years of its existence. It has set up qualifications for Fellowship of such a nature that the public may have confidence that every Fellow of the College is in fact worthy and competent to practice his designated branch of the art of surgery. The results accomplished by the College in its standardization of hospitals are world renowned, and the work of its committees on fractures, cancer, sarcoma, and traumatic surgery has contributed greatly to the improvement of the quality of surgical service supplied to the community.

Within the past few years, however, it has become increasingly apparent that competent medical and surgical service is not everywhere to be obtained by all classes of the population.

Depression and unemployment have been responsible for the more general appreciation of these facts and have indeed been to a considerable extent the cause of them, but few will deny that the provision for efficient medical and surgical service, including preventive medicine, has not for some time past been sufficient to meet the needs of all classes of the community. As Fellows of the American College of Surgeons, these facts deserve our serious consideration.

In the 20 years which have elapsed since the beginning of the great war, profound changes have been taking place throughout the world which have so altered the habits and thoughts of people of all nationalities as to produce almost a new civilization. During this period the advances of science have been unprecedented, and the application of these advances to the daily life of the people, whether in the form of new inventions to enhance their comfort and happiness, or as additions to the resources of medical and surgical science for the protection of their health, has contributed greatly to the welfare of mankind. This has been a period of mechanical and technological ascendancy and of quantity production. In the widespread development of new methods of production and distribution of the essentials of existence, it is not surprising that the older methods of supplying medical and surgical service should have been criticized as ineffective. As a matter of fact, medical practice has not remained alto-

gether immune to these new influences, and the development of specialization in medicine and surgery is an example of the modifications which the scientific advances of this period have made necessary, as the sum of medical knowledge has increased. It is as a result of these developments that the group method of practice has come into existence.

As a rule, however, the medical profession has resisted attempts to extend mass production principles to the practice of medicine. It is their belief that the peculiarly personal and fiduciary nature of the relation between patient and physician is too precious a relationship and one of too much value to the community to be jeopardized by radical changes of a socialistic nature. This attitude on the part of the profession is one to be commended rather than condemned. The individual member of the community is dependent upon his medical advisor for the maintenance of his health and functional efficiency. In the opportunity to select the physician or the hospital in which he has confidence rests the first step in that relationship of trust which plays so great a part in the satisfactory conduct of medical practice. The physician has been trained to accept the grave responsibilities that are involved in this fiduciary relationship, and the Hippocratic oath is evidence sufficient that this important feature of medical practice has been recognized both by the public and by the profession since before the Christian era. This peculiar responsibility of the physician is further safeguarded by the code of ethics which is universally accepted by the medical profession. This code of ethics is designed primarily to protect the patient and the community, by the elimination of those physicians who are unworthy or unwilling to accept the altruistic principles upon which the satisfactory conduct of the practice of medicine must inevitably rest.

Living conditions in this country, however, have been profoundly altered in the past 5 years. Depression and unemployment have reduced many individuals from a position of relative independence to one of indigence, and have brought those who were once in easier circumstances down in the scale of living below the comfort level. At the same time the reduction of the incomes of the well-to-do has been such that sums they formerly contributed to charitable purposes

<sup>1</sup>Inaugural Address, presented before the Clinical Congress of the American College of Surgeons, Boston, October 25, 1934.



physician must be prepared to give surgical as well as medical service, especially in emergencies, for he is frequently the only possible source of aid at such a time. The American College of Surgeons now carries eleven thousand surgeons on its rolls as Fellows of the College, but it would be manifestly impossible for all the surgical service needed by the community to be given by these qualified surgeons alone. For emergency service and for minor surgical procedures the community must not infrequently be dependent upon the general practitioner. Let it be said at once that the efficiency with which such service is supplied, day in, day out, all over the country by physicians in general practice is deserving of the highest praise and the widest recognition.

For major surgical service, however, prolonged training, more intense application to this restricted field, adequate laboratory and hospital equipment, and the judgment and dexterity obtained only from experience are qualifications which the physician in general practice cannot readily obtain. The more specialized surgical service of the community must therefore be provided by those who have established their ability and fitness to give this service, and these qualifications Fellowship in the American College of Surgeons is designed to certify.

When we reflect, however, that in spite of the lack of any legal restraint the medical profession has been so effectively controlled by its principles of ethics as to prevent the abuse of public confidence by the individual practitioner attempting to do surgical work beyond his capabilities, we must acknowledge again a high degree of moral sense and altruism as having been established as a tradition of the medical profession.

The American College of Surgeons represents the only existing organization designed to establish definite and distinct qualifications for the practice of surgery. Similar organizations exist for the qualification of specialists in some of the other branches of medicine, but the field is by no means covered by these independent agencies.

The amalgamation of all of the different boards for the certification of specialists under some coordinating influence is at present under consideration and would undoubtedly lead to a more satisfactory appreciation by the public, as well as by the medical profession, of the value of such qualification. It would be unreasonable and unwise, however, for the individual State Boards of Registration to attempt each to set up its own standards for the licensing of physicians and surgeons in the different specialties. Certification of specialists should be national in scope, reasonably

uniform in its requirements, with due regard to the varying demands of each form of special service, and above all things, should demand a broad general medical and surgical training as a foundation upon which specialization may be firmly based.

Since no single national organization exists at the present moment for the certification of physicians and surgeons as to their qualifications for practice of all of the different special lines of medical activity, we must seek some other means of classification if we desire to deliver the most effective service to the community. Such a means is available to us in the hospitals. All but the smallest hospitals maintain such a division of their staffs, varying from the primary separation into surgical, medical and obstetrical divisions up to the divisions of the larger hospitals into separate services and clinics in 15 or 20 different specialties of medical and surgical practice. Physicians and surgeons in hospitals are further classified into permanent staffs and courtesy or associate staffs, but no hospital worthy of the name fails to exercise control and supervision over the work of its staff to give serious consideration to the qualifications of candidates for its staff appointments or to withhold appointment from those who are not professionally qualified or are otherwise unworthy.

The classification of specialists which is provided by the hospitals may well be utilized in any plans for providing more efficient service to the community. Since the hospitals themselves are an essential part of any such project they may prove to be the most satisfactory units with which to construct these plans and in any case their co-operation and participation will always be an absolute necessity.

It is not necessary, however, that such plans should be restricted to hospitals which have been approved by the American College of Surgeons. The advantages of such approval are today so obvious to the trustees, staffs, and patients of every institution and to the public as well, that no small part of the benefit which has accrued to the community from the hospital standardization movement is the notable improvement of conditions in *all* hospitals including particularly those which have not yet succeeded in reaching the minimum standard of the College but which are steadfastly approaching that goal of their ambition.

From early colonial times up to the present day, it has been an accepted principle in this country that the maintenance of the destitute and their medical and surgical care are an obligation upon

the community. This obligation has been discharged more, or less completely by means of private charity, through endowments, or by local taxation. Only recently, and we must hope temporarily, because of the inability of these resources to meet the increasing demands occasioned by unemployment and depression, has it been necessary to call upon the state and federal governments for financial support of these activities.

The official machinery of the community by which these responsibilities have been met has varied from the appointment of a city physician in the smaller communities, to the establishment of Welfare Departments, overseers of the poor, and city and county almshouses and hospitals with medical officers on a full-time salaried basis or giving only part time service with or without remuneration. In addition to these services for the indigent, organized public health departments have been established in cities and towns, as well as by the state, to supply the needs of the community as a whole in the way of health administration, sanitation, the preparation of vital statistics, and quarantine measures in the community. In many states, however, a considerably broader program has been developed by public health departments, involving health education, demonstration clinics, research in public health problems, the provision of biological products for therapeutic purposes, and similar measures. The maintenance of institutions for the care of the insane and of the tuberculous, although not as a rule directly under the supervision of the Department of Public Health, represents another important and necessary medical activity of the local or state government.

The development of the public health services has been a gradual one and from its very beginnings it has been supported and guided by the medical profession. Of late years, however, there has been a disposition on the part of the profession to be critical of some, at least, of the more recent expansions in the field of public health, on the ground that the state was thereby encroaching into direct competition with the practicing physician. Where the practicing physician is properly equipped to give efficient service, such competition must be condemned and medical or surgical service by the state should be restricted to the indigent. Where such is not the case, however, no one is better aware than are the members of the medical profession that more efficient service made available by means of the financial resources of the state is of the greatest benefit to themselves and to their patients, and they are quick to avail themselves of these resources.

Just as the education of the public is a necessary service to the whole community, so also is the fulfillment of any project for providing more efficient service to the whole community, so also is the maintenance of the public health.

The problem of providing efficient medical and surgical service to the whole community is at the present moment seriously complicated by the deploable ignorance of large groups of the population in regard to what efficient medical service really implies. The enormous sums expended annually for patient medicines and for the services of the quacks and cultists show that in many cases it is ignorance rather than economic conditions which lead people to such deplorable waste of their resources and of the opportunity to regain their health at the same time.

It must be clear to every one that it would be a waste of effort to make efficient medical and surgical service available to the whole community, unless or until the individual members of the community are sufficiently informed to make them ready to accept this service. At the present moment, while the demand is undoubtedly great, it is by no means universal. The ignorance and the credulous represent a formidable group throughout the country, and for their own sakes, as well as for the safety of the community at large, they must be educated rather than coerced to protect themselves. Today, with toxins and anti-toxins, vaccines and serum tests, with insulin and other hormones and vitamins all based on accurate experimentation in the laboratories, and with the X ray and other physical agents at our disposal, no one who is informed can doubt that physical, chemical and biological science is the foundation upon which the edifice of modern medicine has been constructed. This knowledge of the basic facts of medical science must be more widely published, in order that people may accurately estimate the futilities of the quacks and cultists, and the follies they advocate in the way of treatment of disease. Campaigns of public education of this nature can be carried out with propriety by the great national organizations of physicians and surgeons, as well as by city, state and federal public health departments. The individual practitioner, who must restrict his part in public education to the instruction of his own patients, has the right to look to the larger organizations to fulfill this manifest public duty.

postgraduate instruction of the medical profession. Physicians and surgeons who are not in close proximity to the centers of medical education are of necessity limited by their continued occupation in competitive practice, by the paucity of their professional income, and by the great amount of charity service they now supply, in their opportunities for postgraduate study. In a profession which advances as rapidly as does medicine, text books become out of date almost as soon as they are published. Medical journals and medical societies attempt to keep the practitioner informed of the notable discoveries of importance in medicine, but the practical estimate of the comparative value of these new developments is more difficult for him to obtain.

Of late years steps have been taken by a number of state medical societies to make available postgraduate instruction in medical and surgical subjects by bringing instruction to the physician instead of obliging him to leave his practice to go to some medical center to obtain it. Such plans are meeting a long felt want and give good promise of raising the general standard of medical and surgical efficiency, but the needs for postgraduate instruction of the medical profession throughout the country are as yet but inadequately supplied.

From the point of view of their ability to pay for medical and surgical service, there are at least three classes of the community to be considered namely, (1) the indigent who cannot pay at all, (2) those of adequate means who can afford to pay for what they need, and (3) the intermediate group or those of moderate means who can pay for minor medical service but cannot unaided finance the expenses of serious illness or prolonged hospitalization within their restricted incomes.

The care of the indigent sick has long been recognized as an obligation upon the community and one which either through official sources or by private charity has, to a certain extent at least, been satisfied. So far as hospitalization and nursing care are concerned this is frequently the case but all too often physicians and surgeons have been expected and permitted to contribute their services gratuitously for the care of this portion of the population.

The physician who serves the community should not be expected to stand in any different relation from that of other professional men who qualify for the public service. Except in teaching hospitals, where some equivalent other than financial return accrues to the physician or surgeon, in the way of reputation or opportunity, his services should be paid for as are the services of lawyers

engineers and other professional men who serve the city or the state.

Many communities already provide hospitals for the indigent sick maintained by public funds. When, owing to unusual circumstances such as those which exist today, the demand exceeds the accommodation available such cases can very properly be accommodated in other institutions or in their own homes, and their care be paid for by the community on a cost basis and with a fee schedule for professional services on a minimum but reasonable scale.

Such a plan has already been authorized by the Federal Government for the medical care of dependents in the F. L. R. A. and the C. W. A. in their homes or in the doctor's office. While the many forms and records with which the government finds it necessary to protect itself are unfamiliar and annoying to the physician, an important principle has been established that the government recognizes its obligation to remunerate the physician who serves the community by taking care of the indigent, even though such remuneration is at present on a scale which must be regarded as a minimum.

The medical and surgical care of the well-to-do is reasonably well organized at the present time, and no great modification of private practice, as at present conducted, need be contemplated. It is undoubtedly true that very considerable expenses could be saved in caring for the well-to-do if they and their physicians and surgeons were disposed to eliminate some of the expensive laboratory tests, X-ray examinations and consultations which are so frequently demanded when their necessity is not apparent in the uncomplicated case. Such extravagances can only be avoided with difficulty if the patient is anxious to have them and pay for them, but the physician is aware of the fact that the money thus expended would often provide needed hospital care for many patients in the lower income class.

The most difficult problem which presents itself in the organization of medical and surgical service to supply the needs of the whole community is presented by the great mass of the population which falls in the moderate means group. Individuals in this class can be independent and can select and pay for such medical service as they may need only so long as serious illness requiring prolonged hospitalization and continued medical or surgical care is not encountered. When serious illness does come, the middle class patient must either assume obligations in the way of debts which he can seldom discharge, or he must lose his independence and become a burden on the

community. It is to this class especially that it has been proposed to apply the prepayment insurance principle in order to spread the expenses of serious illness over a period of small monthly payments for a number of years. It is a fact that health insurance in one or another form has been adopted as the most promising solution of the difficulties of this class of the population in some 40 countries in the world in the past 30 years.

Health insurance may be either voluntary or compulsory. In almost every other country the attempt has been made to start with a voluntary plan and it has been found necessary later to resort to compulsory insurance, required by national legislation. This is not surprising when we consider the lack of knowledge of health matters, and the common characteristics of improvidence and lack of concern for the future which so frequently govern the actions of the human race. Some of these national insurance plans, as in Russia, involve the complete socialization and abhorrent to our western civilization. This is the form of medical practice which as "State Medical Care," with its inevitable political control and destruction of individual initiative, is regarded by physicians as a menace to the best interests of the medical professions and of the community as well. Other plans, such as the British National Health Insurance Act, involve changes which are far less revolutionary and permit the medical profession to retain control of the medical aspects of the problem, and to this extent at least, are looked upon with less disfavor by physicians who have made themselves familiar with the details of these different projects.

In a country composed of so many diverse elements as those which make up the United States of America, with the population here crowded in great industrial centers, there scattered in agricultural districts, and in other places more widely distributed still over the practically unsettled and frontier districts of the north and of the west, it is not to be expected that any single national plan for providing medical or surgical service to the whole community should prove everywhere to be satisfactory. The problem is essentially a local one to be studied and solved by the members of the individual communities and by trial and error, if by no other means. In these experiments it is of vital importance that the medical profession should take the already the Workmen's Compensation Laws of the several states require industry to apply the insurance principle to the medical and surgical care as well as to the compensation of the injured workman, and the insurance principle seems to be in fact about the only way in which people in the moderate means class can be expected to pay either the hospital or the physician for the necessary costs of serious illness or operation. The machinery for the operation of the Workmen's Compensation Law is maintained by the state. In many states an insurance fund, operated by the state, but contributed by industry, is provided as an alternative to commercial or mutual insurance. We must all believe that the principle of workmen's compensation for industrial injury and diseases has come to stay. In many communities in this country experiments in the way of providing medical and surgical care on a prepayment insurance basis have already been attempted, and the results of their operation are being studied with the greatest interest. Most of the prepayment plans which have been put in operation have been started by industrial groups and involve a restricted territory and one of relatively uniform population. They vary from single group clinics to county medical society organizations State-wide projects of this character, although proposed, have not yet been put in operation. In order to escape the dangers of unfair competition, a plan should include all of the medical and surgical agencies of the local community that are qualified and willing to cooperate in giving such service. If too large, the diversity of population and employment on the one hand, and of medical resources on the other, may endanger the satisfactory operation of any plan. The American College of Surgeons has taken the position that prepayment plans of this nature should be "free from the intervention of commercial organizations operating for profit," in order that the maximum amount of the fund may be available for the payment of the medical, surgical and hospital expense which is to be supplied. Prepayment insurance plans not infrequently have been opposed by the medical profession on the ground that their operation in one way or another involves violation of the accepted code of ethics, especially in the matter of commercialism, advertising and unfair competition. That such dangers are present and must be avoided is clear to the physician or surgeon, however difficult it may be for him to explain these objections to the layman. They rest in fact upon the experience of years of medical practice, and they are based upon knowledge of the weaknesses as well as of the stronger qualities of human nature.

The moderate means group which we have been discussing includes all those with incomes above

the indigent class and below the "well to-do" It would not be unreasonable, however, to make a further subdivision of this large class of the community into at least two smaller groups, namely, (1) those on the *lower level*, whose resources, even when they are employed, could not be expected unaided to provide, on a periodic payment basis, a sufficient amount to pay the cost of full medical and surgical service, and (2) those of the *upper level*, who can through periodic payments, assure themselves of sufficient resources to obtain this service without resort to community help or public funds. The lower level group of the moderate means class are the members of the community for whom the provision of efficient service presents the greatest difficulties.

The difference between the amounts which individuals in this lower level group can pay and the actual cost of the service supplied must be obtained from other sources. In this case, as in providing for the indigent, the responsibility must devolve first upon the community. Many who now as indigents receive charity service undoubtedly belong really in this lower level group. A rigid investigation of their economic condition is necessary for their classification.

By virtue of the fact that the community is paying all of the expenses for the care of the indigent and a proportion, at least, of that of the lower level moderate means group the community itself should assume the responsibility for the quality of the service thus supplied.

The upper level group of the moderate means class may be counted upon to carry their own medical and surgical expenses, provided hospital accommodation and efficient medical and surgical service can be made available to them on a basis of minimum fees. Within the past few years many hospitals have developed special intermediate wards for patients of this group, where hospital expenses are reduced to a minimum by the elimination of non essentials and a correspondingly reduced fee for professional service is collected by the hospital and paid to the physician or the surgeon in charge of the patient. Voluntary prepayment plans for hospital expenses or even for full medical and surgical service can undoubtedly be organized in connection with such services and are greatly to be preferred to the present commercial health insurance projects which have been developed widely and have received such severe criticism in a number of states in the past few years. It is of great importance, however, that prepayment plans of this nature be not restricted to individual hospitals or smaller groups. They should be a *co operative community organiza-*

*tion* in order that all unfair competition may be avoided.

Great difficulty will be found in defining accurately in dollars and cents the limits of these different economic classes. Standards undoubtedly will vary from one community to another. What ever criteria may be established in a given community in regard to this classification on an economic basis, its observance should be rigid. One of the grave criticisms of the administration of our charity hospitals today is based upon the fact that the actual need for charity medical service is not always established beyond dispute in every case admitted to its wards. While the extent of this abuse undoubtedly varies considerably in different communities, those who seek undeserved free medical service at the expense of the truly destitute, must be meticulously sought out and prevented from obtaining such advantages. On the same basis the enjoyment of moderate means accommodations and reduced fees in hospitals should be rigidly restricted to those of limited resources whose finances do not permit them to obtain needed care in private practice.

The Medical Service Board of the American College of Surgeons has laid emphasis upon the necessity for strict observance of the code of medical ethics in the conduct of these new and experimental methods of supplying service to the community. In the consideration and evaluation of their success the medical profession must unavoidably be guided by the extent to which the new plans permit adherence to this code. Wide latitude is given however, within these limits for the trial of such new methods of practice as may be suited to individual communities. The co-operation of the medical profession is essential to their successful operation and should be as freely given in this emergency as are their services on every other occasion where their need is manifest.

The co-operation of other groups than the physicians is also to be desired in consideration of these plans. Data of great importance have already been collected upon this general subject. The vast majority of the medical profession has hitherto paid but scant attention to great national social and economic problems. From the social ogists and economists much important information is to be obtained, and a closer and more harmonious co-operation between these groups and the medical profession appears to be the great need of the present moment, in order that each may contribute of its knowledge to the solution of perhaps the most important question which affects the physical welfare of the community in the present generation.



In the Hospital Department of the American College of Surgeons we possess already an orderly manner for the survey of the hospitals by trained investigators. Through this department of the College accurate data in regard to such local prepayment or insurance plans as are now in operation or may be developed in the future, can be readily obtained. It would seem at the present moment that the information we need upon which to base judgment as to the value can thus be secured at less expense than in any other way. It would be advisable, therefore, to continue the collection of this information in order that it may be made available to those who are studying these problems.

The responsibility of industry for maintaining adequate emergency medical and surgical service for its sick and injured employees is at present widely recognized. The Board on Industrial and Traumatic Surgery of the American College of Surgeons has contributed in no small degree to improving the quality of this service by the establishment of minimum standards for industrial surgical services, based upon the fact that proper qualifications over and above those necessary for a state license to practice medicine, must be required of those engaging in this special form of surgery. The field of industrial medicine and surgery includes not only a consideration of the requirements of the Workmen's Compensation Laws of the several states, but as well a more extended program of medical and surgical supervision of the health of employees by physical examination, by study of the work hazards and requirements of the special industry, by health education, and by the practice of preventive medicine.

Smaller industries and, in certain parts of the country, even those of larger size, have frequently chosen to entrust the risks and expenses of industrial accidents and workmen's compensation requirements to commercial insurance companies or "partners," organized to assume these obligations. It is not unreasonable of course to expect that the responsibility of the insurance company, under these conditions, should become practically that of the original employer so far as goes the obligation to supply adequate and qualified surgical service in the emergency treatment of the industrial accident case, and that in its subsequent supervision, it should ensure that competent employ or himself or the insurance company which has accepted the responsibility for him is paying the expenses of such treatment and has a corre-

No single health insurance plan of national scope appears at present to be applicable to the conditions existing in this country. The matter is at present one for local study and experiment. In such a study the best medical and surgical ability in the community is needed, acting in co-operation with others qualified by their knowledge of economic conditions to join in the solution of the problem. Some support derived from the community, to supplement any possible prepayment insurance plan, may possibly be needed to meet the requirements of individuals in this class. With further progress in health education those in the upper level of the moderate means class may well develop an interest and a desire to participate in voluntary prepayment plans, beginning perhaps first with hospitalization alone, and extending ultimately to full medical, dental and nursing services.

It is greatly to be desired that the trial of these new methods of providing medical and surgical service should be encouraged in different communities where the co-operation of the hospitals, the medical profession and others interested in the maintenance of the public health can be secured. Certain general principles which should be observed in the organization and operation of these plans have already been approved by the College. The Hospital Department of the College provides a ready means of securing accu-

spending interest in the successful outcome of the case, with a minimum of loss of time and a maximum of ultimate functional efficiency, justifies their insistence upon the adequate qualifications of the surgeons who give this special form of service. For the moment, the most practical way to secure these qualifications is to encourage those hospitals and those surgeons who desire to do this form of surgical work to meet the minimum standard established by the Board of Industrial and Traumatic Surgery of the American College of Surgeons.

With this necessarily brief review of some of the many different and somewhat conflicting factors which appear to demand consideration in any concerted movement to supply more efficient surgical service to the various economic classes of the population, we may well conclude that further information must be obtained by carefully organized and critically studied experiments before it will be possible for a final program of action to be prepared.

rate information in regard to these plans and their operation, which should continue to be utilized to accumulate facts on which future judgment may be based.

While the advantages and disadvantages of the different plans for health insurance are under investigation in this laboratory of experience, a number of other steps are immediately open to us which should be of material help in providing more efficient service

- 1 The value of the code of ethics of the medical profession in the protection of the interests of the whole population must be more widely appreciated by the public

- 2 The medical and surgical care of the indigent sick must be recognized everywhere as an obligation of the community

- 3 The segregation of hospital wards for patients of moderate means who can and should

pay minimum hospital expenses and reduced fees, should be more widely practiced

- 4 Abuses of hospital charity by those who can afford to pay must be prevented

- 5 The expansion of the activities of public health departments into the clinical field should be restricted to demonstration clinics for educational purposes and to such other activities as can be made available to the community only by the use of public funds

- 6 The education of the public in regard to health matters, and the postgraduate instruction of physicians should be more widely developed

- 7 The quality of service supplied to the community should be recognized both by the public and by the medical profession as the first and most important consideration in every plan for providing more efficient surgical service and making it available to all classes of the population

## CANCER CLINICS AND CANCER SERVICES IN GENERAL HOSPITALS<sup>1</sup>

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The support of cancer research, therefore, both by persons of wealth, who may be able to devote endowments or contributions to this most important field of investigation, and by the use of public funds, should be urged by every member of the medical profession, as one of the most necessary fields for medical investigation. On account of the expense of construction and maintenance of cancer institutes and special cancer hospitals, the fact must be accepted that a sufficient number of such institutions cannot at present be provided to take care of any considerable proportion of the cancer patients in the country.

Special cancer clinics and cancer services in general hospitals were next considered, and because of the small expense involved in their maintenance and the fact that their organization permitted the same group method of approach to the individual cancer patient which has been the essential feature of the service given by the cancer institutes and special cancer hospitals, the development of such special clinics in general hospitals was strongly advocated. As a matter of fact, two forms of cancer clinics in hospitals were recognized: (1) the fully equipped treatment clinic and (2) the diagnostic clinic without complete treatment facilities. Both forms of clinics, however, employed the group method of study of cases. It was hoped that diagnostic clinics would be inspired to obtain the necessary professional experience and the material equipment to develop into treatment clinics, and be enabled thereby to give full service. In some instances this development has occurred, and if it were not for the difficulty in securing sufficient funds for the necessary equipment under these conditions of depression, such developments would probably have been possible in many other cases.

The Minimum Standard for Cancer Clinics in General Hospitals which was established by the American College of Surgeons includes six paragraphs dealing respectively with the details of organization, conferences, patients, equipment, records and treatment. The details of these requirements need not be repeated here. They can be secured by anyone who is interested from the office of the College and are already familiar to many who are present.

The situation may be briefly summarized, however, as an attempt on the part of the College to

FOUR years ago the Board of Regents of the American College of Surgeons announced its approval of plans for the development of special cancer clinics and cancer services in general hospitals. This action was not taken by the Board of Regents without due consideration of the presumed advantages as well as of the possible disadvantages of such a segregation of cancer patients from the general medical and surgical services of hospitals. Time has not yet elapsed sufficient for final judgment as to the value of these special clinics, but it would seem to be appropriate at this time to review some of the opinions which have been expressed in regard to the advantages and disadvantages which may result from their organization, and to consider to what extent their operation during the past 4 years has justified this recommendation of the College.

The report of the Committee on the Treatment of Malignant Diseases which was accepted by the Board of Regents and published in October, 1930, emphasized the fact that cancer institutes in which both clinical service and research were carried on simultaneously required such large endowments for their support as to prevent their establishment in any considerable number of centers throughout the country. It was recognized, however, that such institutes formed the most effective method of providing treatment for cancer patients who could obtain their services.

Special cancer hospitals, with adequate charitable endowment or supported by the state, were acknowledged to be the next most effective method of providing cancer service. Such hospitals may be expected to provide diagnostic and therapeutic facilities of nearly as high a grade as the generous endowment or other support required for the maintenance of laboratories and of the full-time research staff qualified in the several different branches of science which are required to carry on effective cancer research.

The American College of Surgeons is concerned especially with the quality of service which can be supplied to patients with cancer, and its recommendations were designed to improve this service. The vital necessity, however, for the continued laboratory investigation of cancer as acknowledged by surgeons as well as by all other physicians who have to deal with this disease

procure more efficient care for the cancer patient by establishing the following general principle. The patient's interests are best served when the representatives of the several branches of medical science concerned in the study and treatment of cancer, work together in a co-operative manner, instead of arrogating each to himself a limited field in which his own influence is paramount. That such a condition of individualism was almost universal a short time ago is abundantly proved by the publication in medical literature of many articles dealing with the treatment of cancer by writers who displayed so prejudiced a view in favor of their own special methods as to indicate conclusively their ignorance of the accomplishments of other branches of science in this extensive field. In this narrow attitude the surgeons have been perhaps the chief offenders, but intolerance of the views of others is by no means confined to surgeons. It is a common human failing but in this instance it may be overcome by the group method of co-operative study and discussion designed to provide for the cancer patient the most effective treatment which contemporary medical knowledge will permit.

The advantages to be secured by the establishment of cancer clinics in general hospitals may be listed as follows:

1. The patient receives more complete study and more efficient treatment.

2. More accurate and complete records are secured for subsequent analysis of end results with a view to the increase of knowledge. The use of the standard abstract record forms of the College assures more accurate recording of data and a uniform system of classification for cancer in all of its more important situations.

3. The follow up of cancer cases after treatment is more systematic and contributes to the welfare of the patient as well as to the accumulation of more accurate knowledge.

4. Concentration of the cancer material of the hospital in the hands of a group provides greater experience for the individual members of the group and aids the development of their proficiency and productivity with resulting benefit to the patient, to the hospital and to the community.

5. The conference meetings of the clinic staff provide opportunity for more adequate undergraduate and postgraduate instruction in the subject of cancer and its treatment, and the reference of patients to the clinic by physicians in private practice permits the extension of this educational influence widely throughout the community.

6. The special cancer clinic provides a convenient and inexpensive method for supplying expert consultation service to aid the general practitioner and his patients in securing the diagnosis of cancer in its early curable stage.

7. Without material extra expense, and by mere rearrangement of services in the hospital in such a way as to entrust the cancer work to those who are more interested in this subject than in other special branches of surgical activity and are qualified to assume these responsibilities, opportunity for more efficient service to the patient is secured.

In order to estimate the extent to which cancer clinics in general hospitals have demonstrated their hoped for advantages in the brief period since they have been in operation, we must consider these seven items one by one.

1. The first item to be discussed, and the one which is, and always will be the most important is the question as to whether the cancer patient does in fact obtain better treatment in the cancer clinic than under the old regimen. It would be indeed surprising if the opportunity provided for more careful study of the cancer patient by the group did not result in more accurate diagnosis of the actual stage of the disease. Cancer in its many situations presents a number of different paths of dissemination and frequently different sites of predilection for metastasis can be recognized. Some of these peculiarities are characteristic of the histological type of tumor under consideration, and others are determined more by its anatomical situation. Thus the more experienced study of the group often discloses remote metastases which are positive contra indications to the attempt at radical cure of the disease by surgery, and the patient is thereby protected from unnecessary operative measures which would be doomed to failure in any case.

The close association of the surgeon and of the radiotherapist in the cancer clinic permits them also to co operate in providing more efficient palliative treatment in the advanced cancer case. The combination of radiation therapy and of surgical measures can frequently be effectively employed to bring about relief of distressing symptoms, and even to accomplish temporary "arrest" of the malignant process, with the result that the patient may live for a long period of relative comfort and even die *with*, but not *of*, cancer, as a result of some intercurrent disease.

The early diagnosis of cancer is promoted, first by the greater diagnostic experience of the special staff, and, second, by reason of the possibility of exploratory operations, which can be performed

with safety in many instances only under restricted conditions, with competent roentgen section diagnosis available, and with the immediate completion of such radical operation or radiation treatment as may be indicated in the individual case.

Finally, only by consultation, such as obtained between the surgeon, the radiotherapist and the pathologist in the clinic, can a wise decision be made in the many cases of cancer in which the choice between surgery and radiation treatment, or a combination of the two, is dependent not upon any general rule, but rather upon the conditions existing in the individual case.

Such considerations as have been mentioned are, however, still somewhat theoretical and the more efficient care must be determined by the attitude of patients and of their medical advisers toward the services of the clinics. Everywhere the attendance at cancer clinics is on the increase in some hospitals in which the reference of patients within the hospital is voluntary and not obligatory, the attendance at the cancer clinic has been steadily increasing year by year. There were 14 cancer clinics in the country in 1920 and they were chiefly in cancer institutes. In October, 1933, there were 158 approved by the College, and some 155 in course of organization or awaiting survey. Such a development must indicate that the belief is widely held that through the organization of a cancer clinic, the patient obtains more efficient treatment.

That the establishment of cancer clinics leads to the making of more accurate and complete records of cancer cases can hardly be denied. No one who has looked up hospital records of 10 years ago with the object of studying a group of cancer cases, but has discovered many individual records so lacking in the data now considered essential in the way of history, physical examination, pathology, and details of treatment as to be of no value whatever for classification or analysis. With the interest of the special group composing the clinic staff in preserving accurate and complete records, and with the aid of the standard abstract forms prepared by the College, the records of cases in the cancer clinics have been greatly improved. The element of uniformity alone, obtained by the use of the standard abstract forms, is a material advantage, since a uniform method of recording and of classifying cases permits the collection of data on a much wider scale than heretofore, by the assembly of records from many different clinics, and makes possible a

4 The concentration of the cancer material of the hospital in the care of a relatively small group gives opportunity for a much richer experience and increased opportunity to the individuals selected for the cancer clinic staff. It is not unreasonable, of course, and rather is it to be expected, that this special assignment of privileges to one group shall be compensated by similar assignments to other groups of other branches of special work, such as fractures, incisional cases, or similar subjects of special interest, as a *quid pro quo*. Such assignments may be only temporary and of this sort is often advisable in the case of junior members of the staff.

The surgeon who receives an assignment to a special clinic, whether it be by the direction of the chief surgeon of the hospital or by the decision of an executive staff committee, should accept it as a privilege, which it becomes immediately his duty to justify. Such justification must be dem-

onstrated not only by the increased efficiency of service given to the patient, but by such study and investigation of the hospital clinical material, as will add to the professional reputation of the institution

5 The essential feature of cancer clinic organization is the group attack upon the cancer problem. The group must include primarily one or more representatives of each of the three special branches of medicine which are most intimately concerned with the study and the treatment of cancer surgery, pathology, and radiotherapy. Each of these different individuals brings to the group-study of the cancer patient special knowledge and experience which has been acquired only through a long period of study of these special lines of medical science.

Until the group study plan was inaugurated prejudices and misunderstandings extending even to bitter accusations of violation of the ethical principles of medicine were not uncommon among the representatives of these different specialties concerned with the treatment of the cancer patient. It is extraordinary to observe the readiness with which such biased judgments disappear when free expression of opinion and experience can be secured in personal conference over the problem of the individual case.

Such conferences are first and foremost of advantage to the members of the group on account of their educational effect, but this educational advantage is by no means confined to the individuals participating in the discussion. It extends immediately to the junior attendants, internes, medical students and nurses, who are connected with the clinic, as well as to members of the general hospital staff and to physicians who desire to attend the conference as visitors in order to keep in touch with progress in the diagnosis and treatment of cancer.

A further extension of the educational influence of the cancer clinic is the practice prevalent in many clinics of encouraging the physician who refers his patient for advice to come to the clinic with the patient and share in the group discussion of the case. When this is impossible a letter is usually written to the physician who sends his patient to the clinic giving the full details of diagnosis and of the treatment advised. Such measures not only extend the educational influence of the clinic, but they also procure the co-operation of the physician in the subsequent follow up of the patient to the advantage of all concerned. In fact the educational advantages of cancer clinics are so readily appreciated as to be hardly open to discussion by any one familiar with their operation.

A cancer clinic in a general hospital provides expert consultative service at a minimum expense to the medical profession of the community. The difficulties encountered in the diagnosis of cancer in its early and local stages are widely recognized. The general practitioner without the experience or the equipment to solve these problems is further handicapped in dealing with a doubtful case by the fact that he cannot afford to get the reputation of being an "alarmist", neither does he wish to refer his patients unnecessarily for consultations involving loss of time and travel expenses as well as heavy consultation fees. For reasons such as these, he is tempted to delay. Unfortunately, this delay may be of vital significance in determining the success or failure of treatment in the individual case which actually proves to be cancer. When consultation involves merely a visit to the nearest general hospital with a minimum of expense and loss of time, this occasion for delay is done away with to the advantage of the patient and of his physician as well.

From the point of view of economy, there is no doubt that the cancer clinic in the general hospital has advantages that are not to be gainsaid. It provides within the limitations of the professional ability of the staff and of the equipment of the hospital, a service patterned on that of the major cancer hospitals and institutes. This is accomplished by the simple reassignment of the services of the hospital staff and a corresponding classification and redistribution of its patients.

In the surgical staff of every hospital, there are some surgeons who are interested in one phase of surgery, and others in another. Such interests are recognized by every chief surgeon in the assignments he makes of the hospital material. The establishment of a cancer clinic is but a slight extension of this plan, involving the participation of the staffs of the surgical, the pathological and the radiotherapy departments, and of suitable representatives of other services, such as medicine, gynecology, genito-urinary surgery, otolaryngology and dermatology. The co-operation of the neurosurgeon, the orthopedic surgeon, and the dentist is also much to be desired. The only extra expense the hospital need consider is the provision of suitable space for examining rooms and for clerical and social service workers, and a convenient conference room. The salaries for clerical and social workers must, of course, be included. Most general hospitals are already equipped with all of the surgical instruments and apparatus required for the diagnosis and treatment of cancer, and many have excellent X-ray equipment for therapy as well as for diagnosis. In some hospitals radium

in sufficient quantity is already available for treatment. Where this is not the case, the greater expense of purchase of radium must be considered rare in need be extended beyond the hospital, but an established reputation along some special line inevitably brings the demand for consultation service from professional colleagues. This subdivision of the work of a cancer clinic is further an economy of time. In clinics which are open every day, one day of the week may be devoted to one group of cases and the next day to another, to the obvious advantage of conservation of the time and energy of the staff and the avoidance of undue delay on the part of the patient.

Another objection which has been raised against the organization of these special clinics is that the term "cancer" creates apprehension and some times despair on the part of some of the patients who may be advised to come to the clinic for consultation. This feeling is so strong in certain communities that the alternative term of "tumor clinic" has been employed as an euphemism, although the clinic carries on exactly the same functions under either name. As a matter of fact the progress of public education has already brought about a change of attitude on the part of the public toward the term cancer. The subject is discussed more freely and with far less apprehension than was the case 20 or 30 years ago, and this supposed disadvantage will probably disappear entirely in a few years more. If not, the use of the term "tumor clinic" is an easy remedy.

In conclusion, we may say that the suggested disadvantage involved in the organization of cancer clinics in general hospitals—that it tends to make the treatment of cancer a specialty—must be admitted. It does, and it does so intentionally, but it is a group specialty, not an individual one. There is abundant evidence that under the group method of study and of treatment, the patient, the physician in general practice, the surgeons of the country, and the community itself believe that the cancer patient receives more efficient treatment. We may conclude, therefore, that there is no occasion at this time to alter the policy of the American College of Surgeons of advocating the organization of cancer clinics in general hospitals. Rather should this policy be reaffirmed, and efforts be made to aid these clinics in every way to provide still more efficient services to the cancer patients seeking their help in the years to come.

The principal disadvantage which has been claimed to result from the organization of a cancer clinic in a general hospital, is that the segregation of the cancer cases and their removal from the general medical and surgical services diminishes the interest and the experience of the physicians and surgeons on these services and tends to restrict the treatment of cancer to a limited group of specialists. This disadvantage must be admitted, in regard to cancer, as it is admitted also in regard to orthopedic surgery, genito-urinary surgery, gynecology, neurosurgery, and a number of other special branches of surgery and of medicine which have developed and flourished as a result of the rapid advance of medical science and the virtual impossibility for any single human mind to acquire and retain in serviceable form the amount of knowledge which has resulted from the medical progress of the past 50 years. The way when one surgeon or one physician could make himself master of all of the information needed to deal efficiently with every of diseases which may present itself, has long since passed, and specialization is the answer to this condition. It is through specialization indeed, that many of these same advances in medicine and surgery have been brought about. Specialization is the price we of this generation are obliged to pay for the benefits we have obtained from the progress of medical science in the past 50 years. Not only must we believe that specialization has come to the point where it is further developed, but we must recognize that its further development is imminent. Even in this special subject of cancer further limitations of the general field are already evident in the subdivisions of interest and of experience on the part of the individuals who are united in the cancer clinic staff. The special interests and the special qualifications which determine these subdivisions of the work of the patient as well as of the staff. It is a form of voluntary division of labor which yields most readily available in the hospital, the expense in other institutions. When such facilities are already available to be met by arrangements with the need may be met by arrangements with other institutions. When such facilities are already available to be met by arrangements with other institutions. When such facilities are already available to be met by arrangements with other institutions.

MEDICINE AND PUBLIC SERVICE<sup>1</sup>

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NO progressive person would return to a simpler life with its primitive practices and superstitions if he could. With all of the complexities and difficulties arising out of a constantly expanding civilization we should prefer to face its problems and to deal with its complexities rather than return to ignorance and superstition in dealing with the issues of life. Every civilization in the long run pays for what it does not have as truly as it pays for the things it possesses, but it pays for the things it does not have with a different kind of coin than it uses in paying for the things it does have. Ignorant and backward nations pay in poverty, destitution, unborn hopes and ambitions, ignorance, and unnecessary sickness for the scale of civilization that they maintain. Under such conditions the demagogue finds the ignorant populace an easy prey to his nefarious schemes. The practice of the various professions such as medicine, law, the ministry, and education is necessarily on a low level under such conditions. The progressive development of the well being of a people calls for sacrifices in effort and money. Every step forward taxes the ingenuity of the people, lays necessary tribute upon their resources, and calls for an increasingly superior quality of service.

What is true of nations in general is likewise true of groups that are responsible for the advancement of their professions. It is true of the medical group. No one would have medical practice revert to the days when we knew nothing of vitamins, of radium, of the roentgen ray and radiant energy, of the chemistry of drugs, of the use of serums or of modern surgery. We are well aware of the fact that contributions to medical knowledge in the last sixty years have exceeded in number and significance the contributions of the preceding three or four thousand centuries, and we have only begun. What lies ahead is entirely in the lap of the gods; it depends to a very large extent on the attitude that we take towards science. This is no time to be talking about science taking a holiday. Indeed the cure of human disease, the alleviation of human suffering, the prolongation of human life—in fact, all those things which contribute in any way to physical and mental health are directly dependent on the further advancement of science. Science cannot halt nor falter in its work, it must study

every change in our social and industrial order, for every change probably creates new diseases, changes certainly modify conditions affecting old ones. Practically every step forward in the march of civilization has been marked by some discovery, some invention, and by the extension and distribution of human knowledge. Mankind is engaged in a continuing process of regeneration, each regenerative step is simply another mile stone in human achievement.

The representatives of the medical profession have certain responsibilities and obligations in common with the representatives of all other professions. The two chief responsibilities that they have are, namely, to advance the basic knowledge and the craft spirit of their own profession and to promote the common welfare. The advancement of the interests of one's own profession is best performed by devoting oneself to his profession. Simple as this seems to be, it is not always done. Too many lawyers, too many teachers and too many doctors worship at the shrine of their avocations rather than at the shrine of their vocations.

From observations ranging over more than forty years in the educational field, I am of the opinion that the surest way for a scholar to win recognition is to become a better scholar, the surest way for a lawyer to become distinguished is to become a better lawyer, and the surest way for a doctor to achieve success is to become a better doctor. Obviously one cannot become a better scholar, a better lawyer, nor a better doctor, except by devoting himself diligently and faithfully to his profession—all of which means that he must, among other things, study and master the new knowledge appearing in his field.

It is true, of course, that there are a number of factors that make this extremely difficult. One is the growth of knowledge itself. It is now extremely difficult, if not impossible, for one to know every thing about a given field of learning, but in so far as it is possible, surely there rests upon the professional man the obligation to be the master of the things that he professes. Another factor that makes it difficult for him to achieve this ambition is that in recent years there has been a tendency to subdivide knowledge and to differentiate and specialize practice. Partitioned practice in the field of medicine certainly

<sup>1</sup> Fellowship Address, presented before the Convocation of the American College of Surgeons, Boston, October 10, 1934.



*L. J. Brown*





I do not recite these facts to condemn the medical profession, only to show what kinds of unfortunate practice may creep in, partly because of the differentiation of knowledge and partly because of blind obedience to the god of specialization

Clearly there is need for the coordination of work among specialists in every organization. Surely one who dissolves a person's lower maxillary should know enough to treat it afterwards. Medical practice cannot be standardized in the way in which industry can be, nor can operations be performed on a mass production basis, but when a doctor confines his practice to the making muscle of the left eye he is really going too far.

While the surest way for an individual to advance himself in his profession is to become more professional, the surest way for any group of specialists in a profession to advance themselves and the interests of their profession, is to coordinate and to organize their activities so as to insure the fullest, freest, and most intelligent co-operation.

Any profession that is constantly advancing will find it necessary to raise its standards from time to time. The people of a country have a right to improved standards. Not only must there be a raising of standards, but means must be provided for the continuing development of those engaged in practice.

I am not much concerned about the number of doctors that we have. I know there is a vast amount of talk among the members of your profession as to whether there is an overproduction of doctors. Figures are cited to show that we have about one physician to every 750 or 790 persons in the United States and that this is a larger number than is to be found in England, Germany, France, or Sweden. It is believed that the presence of so many practitioners is in itself a weakness because it leads to unfair and unprofessional competition. I recall another circumstance which I think has a definite bearing on this particular matter. About ten years ago I was invited to be a lay adviser of one of the great foundations of this country in connection with certain projects that it proposed to make in stimulating a public interest in personal and community health. We proposed to go into a number of communities, some urban and some rural, in various sections of the country, with a view to testing out our theories. When it was announced that we expected to go into a certain city, a city of about 40,000, every doctor in town, I think, joined in a protest against our coming. We were as unwelcome as Mr. Hoover would be in Mr. Roosevelt's cabinet. No doctor

has carried with it all of the wealth of specialism in general and has greatly increased the costs to the patient.

If I may be permitted, I shall cite one personal experience which illustrates what I mean.

I was in another state, I was suffering from some throat trouble. I was anxious to find out what the source of the trouble was and, if possible, to have it remedied. I called on a certain doctor who was a member of a certain clinic and who had a long printed form consisting of some two hundred questions which I was required to answer. These questions asked for far more detailed information than I would be expected to give in case I were applying for insurance, they not only went back to my immediate ancestry, but to my grand-ancestry and my great-grand-ancestry. All of my habits of life were minutely inquired into. After this man had secured a complete inventory of my ancestral history, my physical weaknesses, and of my opinions on all sorts of subjects, he very wisely informed me that he would now take time to examine my report more carefully, but in the meantime he would pass me on to Dr. So-and-so, with the suggestion that this doctor examine my tonsils. Dr. So-and-so placed a long slender piece of birch board down my throat, required me to say "ah" in a half dozen different languages and finally decided that a culture should be taken of the tonsils, but that he would not have it done that day. He did pass me on to a third doctor to have my teeth roentgenographed. When this man had completed pictures of all my teeth, he said, "I never pass judgment on the pictures, I only take them." That made it necessary for me to see another doctor who decided to extract them. "That made it necessary for me to see another doctor who decided to extract them." Still being unsatisfied, I went unsuspiciously to this fifth doctor who provided to have an expert assistant. This man gave me some sort of gas, and while I was under the influence of it the opening in my mouth was removed. Upon my returning to consciousness, this doctor said to me, "That was a very difficult tooth to remove. You have a bad jaw, it will now be necessary for you to have it treated for several days by Doctor ——" Then the explosion occurred. I raised the roof. When I received a bill for the services that had been so generously given me during the afternoon, it was for \$125.

wanted us. But not fully understanding the medical mind, we went into the community nevertheless. We took a group of trained nurses and competent doctors into the community. The nurses began having conferences with expectant mothers and with mothers of infants with regard to prenatal and postnatal care of children. The doctors began having meetings with small groups here and there at which health score cards and charts were devised for the school children. The nurses and doctors who represented the Foundation were persons of rare intelligence and attractive personalities, they were adroit and skillful in meeting people and in discussing matters without offending them. At the end of the year the local medical society, which was composed of all of the doctors in the community, had a meeting and passed resolutions requesting the City Council to levy a tax which would be the equivalent of fifty cents on every person in the community to maintain the service which we had established. What was responsible for this change of heart and mind? The doctors said that there had been no reduction in their business during the year as a matter of fact, it had increased. Their incomes had increased and, furthermore the quality of their work was much higher than it had been a year before. More persons were coming to them, asking for advice, seeking examinations in matters relating to their health and that of their children. The modern knowledge about diagnosis, treatment and prevention of human disease which had been dispersed by these unwelcome guests had raised the quality of medical knowledge and of medical practice to a higher professional basis than ever and the doctors were happy.

Some five years ago while in Russia, I visited a number of clubs that had been established for laboring people. I remember one in particular where there were about one hundred men and women—peasant men and women—listening to a doctor who was talking to them about the simplest things relating to their own health and that of their children and their responsibility for the health of the community. The vacant expressions of these peasant men and women began to light up as they began to understand a little here and there about the things the man was discussing. It was the first time in their lives that they had ever received any instruction along these lines. This campaign for the diffusion of learning, bearing upon physical and moral health, has been carried on widely throughout Russia.

It is my opinion that every time we raise the cultural level of a people we increase their wants, we multiply their needs, we fructify their ambi-

tions. Perhaps the medical profession should take steps to request that none except those who possess adequate ability should be permitted to enter upon the study of medicine, and that none except those with the highest ethical ideals should be permitted to engage in the practice of medicine. But one of the surest ways of solving the over supply problem in this, as well as in every other profession, is to educate the people with regard to the service the profession can render.

Then another one of the problems with which the medical profession is gravely concerned is how to distribute medical services so as to care for large numbers of people. We hear this movement referred to as a movement for socialized medicine. It manifests itself in various forms, in some countries in the form of insurance, in others the government subsidizes medical practice in certain areas, in some instances individuals within a community engage a community doctor and voluntarily levy a tax upon themselves and in others, corporations manufacturing concerns, and business enterprises of one kind or another, engage doctors to care for their employees. The thing that we shrink from in America apparently is the use of the term "socialized" or "state" medicine. It is anathema to many. When Dr. Angell of Yale spoke before this convocation, he said that we should not be disturbed by a name. He advised us to look carefully into the matter and to make our decisions on the basis of facts and the quality of service that we should undertake to render. In our antagonism to a point of view regarding a form of practice, we must not overlook the fact that the recruiting officers of state socialism are want, restlessness, and despair, nor must we overlook the fact that we have many socialistic institutions and socialistic forms of control in America. The American public school system, for example, is the greatest socialistic experiment that the world has ever witnessed. Our fire departments, our police systems, our post offices are examples of pure socialism in government.

The American people are practical people, they are constantly seeking something that works, the test of its success is the quality of work that it performs. The American people are distrustful of abstract ideas, abstract political theories, abstract social theories, they aim to take the course that works best in actual practice. For that reason there is a mixture of every form of control in America—democracy, communism, socialism, constitutionalism, autocracy, dictatorship—each in turn, under differing circumstances, has been approved and has been accepted when the motives

[illegible]

## PRESENTATION OF HONORARY FELLOWS

FRANKLIN H. MARTIN, M.D. F.A.C.S., CHICAGO, ILLINOIS

AT the Convocation on Friday evening October 19, Honorary Fellowships were conferred by the President on the following eminent surgeons

Sir Harold Delf Gillies, London, England—Commander of Order of the Bath of England Commander of Order of the Dannebrog Knight Bachelor Fellow of the Royal College of Surgeons of England Plastic Surgeon to St. Bartholomew's Hospital Introduced by Vice President Charles A. Dukes

Professor Josef Halban, Vienna, Austria—Doctor of Medicine and the Distinguished Professor of Gynecology in the University of Vienna Introduced by Regent Richard R. Smith

Mr. Harry Platt, Manchester, England—Doctor of Medicine, Master of Surgery, Fellow of the Royal College of Surgeons of England, Lecturer in Orthopedic Surgery at the University of Manchester and President of the British Orthopedic Association Introduced by Regent John R. Fraser

Dr. Bethel Solomons, Dublin, Ireland—Doctor of Medicine, Fellow and former Vice President of the Royal College of Physicians of Ireland, Examiner in Obstetrics and Gynecology, Royal College of Physicians and Surgeons of Ireland and in Dunham University Introduced by Regent C. Jeff Miller

## PRESENTATION OF CANDIDATES—CLASS OF 1934

FRANKLIN H. MARTIN, M.D. F.A.C.S., CHICAGO, ILLINOIS

IN behalf of the Board of Regents of the American College of Surgeons I have the honor to present for Fellowship in the College candidates as follows

United States	567
Canada	17
Nicaragua	1
China	2
Chosen	2
Bahamas	1
England	1
India	2
Syria	1
Turkey	1
Total	590

Each year as we receive a new class of candidates into Fellowship I am impressed by the prestige of an institution that can influence such a goodly number of busy practitioners of surgery to seek its portals

To the casual observer these men and women appear as one more group that is being enrolled into our ranks. Complacently, this observer shrugs his shoulders and reflects "How easy!"

As an illustration let us enumerate the facts. There were 4,988 applications for Fellowship on file January 1, 1934. One thousand one hundred and twenty six of them were already ap-

proved by their State or Provincial Committees on Credentials, 1,673 were presented to State and Provincial Committees on Credentials during this year. Of these only 639, or 38.2 per cent, were approved and recommended for examination. Of the total recommended for Fellowship before and since January 1, 1934 (1,765), our careful sifting process has admitted to Fellowship only 590, or 33.4 per cent, constituting the candidates who are here present. Of the total 4,988 applications that were on file January 1, 1934, the 590 accepted candidates represent only 11.8 per cent approved, or 1 in every 8 applicants.

Surely if we pay tribute where tribute is due we must pay full portion to the magnificent group which is before us this evening. Veritably they are the survival of the fittest.

They are to be congratulated, and the College is to be congratulated, but above all, we must congratulate the people who shall in the future seek their services.

Mr. President, inasmuch as the candidates herewith presented have fulfilled all of the requirements for admission and have affirmed the Fellowship Pledge of the American College of Surgeons, on authority of the Board of Regents of the College, I take great pleasure in presenting them for Fellowship.

## CASE HISTORY HONOR LIST AND PRIZE AWARD

ALLEN B KANAVEL, M D, F A C S, CHICAGO, ILLINOIS

placed on an honor list May I ask each honor man to rise as his name is read

Nicholas Gotten, Philadelphia, Pennsylvania  
Wallace L Nelson, Wisconsin Rapids, Wisconsin  
Roscoe W Teahan, Philadelphia, Pennsylvania  
Harry V Thomas, Fairmont, West Virginia  
Clarence H Snyder, Ann Arbor Michigan

On behalf of the College I extend to each of you the congratulations of the Board of Regents upon the excellence of your case histories. And now, may I announce the prize winner from among this group and invite him to the platform to receive the certificate of appreciation from our official journal, and the formal receipt for life dues in the American College of Surgeons?

Will Dr Snyder please come to the platform? Dr Snyder, this recognition of your work is an expression by the College of its belief that a careful analysis of case history elevates the standard of surgery and insures to patients the most efficient care. It is our hope that this expression of commendation may serve to stimulate others to emulate your example, advance the frontiers of surgical knowledge, and benefit those entrusted to our care. I congratulate you

THE Editorial Board of SURGERY, GYNECOLOGY AND OBSTETRICS is so heartily in sympathy with the program of the College and

its demands that all patients should receive careful study, as evidenced by adequate records, that in 1930 it asked of the Board of Regents the privilege of presenting an annual prize in the form of a life Fellowship in the American College of Surgeons for the most acceptable set of case records presented by the candidates during the preceding year. The prize consists of five hundred dollars, invested in the name of the successful candidate for life dues in the American College of Surgeons, and is accompanied by an appropriately engraved certificate of appreciation on behalf of the donor, SURGERY, GYNECOLOGY AND OBSTETRICS.

The prize winners of the last 4 years have come from Louisiana, Texas, Montana, and West Virginia, respectively.

Forty-five histories, outstanding because of their evidence of careful study of the patient, have been selected. These were examined by the full Committee on History Reviews of the College with the name of the surgeon and his address chiminated so that an unbiased choice might be insured. Five sets out of the 45 have been selected as the best and the authors of these records

# SYMPOSIUM: CANCER IS CURABLE

## THE CURABILITY OF CANCER<sup>1</sup>

FRANKLIN H. MARTIN, M.D. CHICAGO, ILLINOIS

Director-General, American College of Surgeons

MAY I cite briefly the objectives which were in my mind when this yearly Symposium on the Curability of Cancer was established in 1932? Through the reports of cancer cures that will follow, it is my hope

1 To impress upon the practitioners of scientific medicine, and indirectly upon the public, the fact that carcinoma is curable by the use of well known and established methods of treatment.

2 To point out in a convincing manner that if all cases of cancer could be diagnosed early and treated promptly in their incipency, the annual death rate from the disease now recorded as 150,000 in the United States and Canada, would be reduced by at least 33 per cent, or 50,000 per year. Even if only one half of the cancer cases could be diagnosed early and properly treated, the death rate would be reduced by 25,000 per year.

3 To bring together the group of distinguished clinicians who reported in 1932 and 1933 and those who are here present—an overwhelming authority—to present definite statements of the impressive number of cases of cancer that have actually been cured. This preponderance of evidence, so convincing as an object lesson, will impel ever increasing numbers of the people to demand facilities, through scientific doctors, for annual or semi-annual examinations, so that not only cancer, but any and all diseases may be discovered in their incipency when they are amenable to treatment.

4. To secure the maximum of ethical publicity of the reports. This will furnish convincing evidence to our hospitals, our local medical societies, and our already established clinics, and encourage them to furnish facilities whereby every physician who is practicing scientific medicine will have available the necessary equipment and trained aids to insure the comprehensive examination of his patients.

5 To convince the profession and the public that even though cancer is already apparently in a later stage of its development, if it is subjected to proper treatment, its progress may often be

delayed, and the disease not infrequently cured to make these facts so obvious that a general policy will be established to treat systematically every case of cancer in whatever stage of advance, not only because of the immediate or remote possibility of a cure but because palliative measures would bring great relief of distressing symptoms, and encouragement instead of forlorn hope.

6 To establish a universal policy among physicians and surgeons to report *cancer cures* rather than to present the involved comparative statistics that dwell particularly on the cases not cured.

If we here present accomplish the full humanitarian purposes for which this yearly symposium

### CANCER CURES—1932 1933 AND 1934

Cervix	7,453
Fundus	1,103
Ovary	525
Vagina, vulva, perineum, and urethra	138
Breast	6,777
Mouth and lip	1,351
Stomach	759
Colon and rectum	2,223
Kidney	1,259
Bladder	346
Prostate	223
Testis	49
Penis	7
Skin	1,000
Thyroid	10
Larynx and hypopharynx	258
Eye	20
Bone	93
Upper jaw and antrum	17
Lower jaw	69
Others	5

Grand total cancer cures 53 cases and over 44,440\*

### SOURCES OF CASES REPORTED

Reported at Clinical Congresses prior to 1934	20,334
Registered cases at American College of Surgeons	1,709
Reported at 1934 Clinical Congress	2,077

Total

44,440

\*This total figure is 24 larger than reported in 1933 on account of the elimination of individual cases which have been reported previously by more than one author.

Presented in the symposium, Cancer Is Curable, before the Clinical Congress of the American College of Surgeons, Boston, Oct. 27-31, 1934.



# CANCER SURVIVALS, WITHOUT RECURRENCE, OF FROM FIVE TO TWENTY-FIVE YEARS<sup>1</sup>

ROBERT SPANN CATHCART M D, F A C S, CHARLESTON, SOUTH CAROLINA

THIS short résumé of malignant tumors falls roughly into two logical classes. Class I consists of the cases treated in the Roper Hospital, the teaching hospital of the Medical College of the State of South Carolina, which cares for the indigent sick of Charleston—city and county. The patients in this class were seen and attended by some dozen odd surgeons including the author. Class II consists of the private cases of the author that were attended in various other hospitals.

A factor that must be constantly borne in mind in evaluating the statistics is that all of the patients in Class I were free bed cases, most were sent themselves in the last stages of malignant disease. At the other extreme are the private patients of Class II, for the most part intelligent and in general consulting the surgeon at a much earlier stage for treatment.

There are, of course, no superficial malignancies included in these statistics. Complete records were obtainable in 74 cases between January, 1934, and September, 1937.

**Breast**  
Class I, 11 cases  
Class II, 25 cases  
Total survival per cent of breast 58  
Alive, 16 (64 per cent)  
Total survival per cent of all cases 21

The very poor survival rate in cancer of the cervix uteri seems to be a combination of two factors, late appearance for treatment and lack of radiation. The latter fault has been completely corrected by the recent installation, in Roper Hospital, of modern deep X-ray therapy and an adequate supply of sufficiently filtered radium. Only widespread public education concerning cancer can get patients to seek medical advice when their malignancy is in its incipientcy.

TABLE I

Organ	Cervix	Breast	Fundus	Stomach	Bladder	Pancreas	Mouth	Rectum	Esophagus	Miscellaneous	Total
Organ	Cervix	Breast	Fundus	Stomach	Bladder	Pancreas	Mouth	Rectum	Esophagus	Miscellaneous	Total
Survived	27	11	1	9	4	0	0	0	4	4	44
Died	1	0	0	0	0	0	0	0	0	0	1
Living 5 years or more	27	11	1	9	4	0	0	0	4	4	44
Living 5 years or more	27	11	1	9	4	0	0	0	4	4	44

The only case treated by radium  
All cases with lymph node involvement. No radium used  
Exploratory laparotomy on 7 No gastrostomy  
No radium, X-ray or electrocoagulation used  
No radium, X-ray or surgery

Organ	Breast	Cervix	Stomach	Colon	Ovary	Total
Survived	25	11	6	1	1	44
Died	1	0	0	0	0	1
Living 5 years or more	25	11	6	1	1	44
Living 5 years or more	25	11	6	1	1	44

TABLE II

1929 There are 6 of these patients still alive, a 5 year survival percentage of 8 (Table I). Class II. Because of the personal records, kept by the author, it has been possible to collect 40 cases of cancer dating back as far as 1909. Of these 40 patients treated surgically for cancer, 20 are still alive, a survival percentage of 40 plus (Table II).

**General comment** The surgical treatment (radical mastectomy) of breast cancer has been the most successful in both classes as shown both in the general survival figure and in the survival figure of the special groups.

The 16 cases lived 5 1/2 to 25 years 3 of the dead cases lived over 5 years and died from other causes  
The 3 cases had radical hysterectomies and died without recurrence  
Stage of surgical gastrectomy

Prescribed in the 4th volume Cancer Is Curable before the Clinical Congress of the American College of Surgeons Boston, October 17 1934

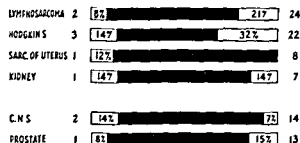


Chart 9 Five years, Group 111

lymphosarcomata lived 8 and 10 years, respectively, and 3 of 22 with Hodgkin's disease lived 5, 5, and 6 years, respectively. Of 13 prostatic cancers, 1 patient who had both prostatectomy and heavy irradiation died of intercurrent disease 5 years later, but among these 13, radical treatment was the exception rather than the rule (Chart 1)

A summary of this report may be seen from the first composite chart—our follow up is 86 per cent complete for the entire 596 cases, and is curiously constant for each of the year periods. Time and effort will improve this.

Our average ratio of apparent 5 year cures is 1 in 4, dropping to 1 in 5 for the 10 year series of 166 cases.

Next to the stimulus this review of our own cases gives us to strive for better future results and greater completeness of follow up, its most suggestive feature seems to us the demonstration of the necessity, in the case of the less frequent types of cancer, for periodic pooling and analysis of comparably recorded data, accumulated by individuals or by large clinics along the lines already laid down by the American College of Surgeons. In that way only can series of the rarer types be secured, large enough to be statistically significant.

# SOME CANCER CURES<sup>1</sup>

MONT R. REID, M.D., AND WILLIAM M. MILLAR, M.D., CINCINNATI, OHIO

From the Department of Surgery of the College of Medicine of the University of Cincinnati and of the Cincinnati General Hospital

## PART I

IN this report we present two series of figures dealing with cancer. One is taken from the ward cases of the General Hospital of the City of Cincinnati and the second group has been secured from the private records of two of the senior surgeons on the staff of the College of Medicine of the University of Cincinnati. It should be realized that when the average surgeon or radiologist enters into the field of statistics he is walking upon dangerous ground and figures of comparative methods and medical "cures" should always be viewed with the greatest caution. In the study of cancer mortality there are entirely too many factors that enter into the question to allow anyone to make any definite statement or to express any positive ideas on the subject. A few of these variables may be briefly mentioned.

A. One should be cautious in dealing with any case below the mean survival age, which is now considered to be about 57 years. For it should be remembered that this is the *mean* age and that "below" that time a "5 year cure" will become less significant the younger the individual happens to be. Statistically speaking, a patient of 35, for example, has a much better expectancy than does a case of 65. This age factor, therefore, has a definite influence on a group of statistics over a wide age period and is too often forgotten by the therapeutic enthusiasts.

B. No one knows how many cases of cancer exist for years without symptoms. All of us can recall individuals who have lived 10 to 20 years without operation and who have finally come to see us because of an extensive ulceration or beginning pain.

C. The position of the lesion is important. The new-growths may or may not be where the patient will soon become aware of it. Then, too, the location is important because of the operability factor that is involved.

Space will not permit any further elaboration of the other numerous difficulties involved. However, these points will tend to show that we cannot as yet view the cancer problem from a purely scientific basis for the great reason that we have no proper control of the many variables that exist. It would seem, then, that the present time the treatment of cancer still depends to a great extent upon two personal equations the

The end results of 317 of these are not known to us. There is no record to be found in either Vital Statistics for a 4 year period following their admission to the hospital for a malignant condition, or (b) in the city directory for 1933-34 (Where an individual or individuals with the same name but different address was found in this book, follow-up letters were forwarded to them in an effort to secure definite information concerning these missing cases.)

The picture set forth in Tables I and II is dreadful. We offer no "alibis" but these results can be explained in part as due to certain conditions peculiar to a City Charity Hospital.

1. The hospital receives its patients from the lower social classes.

2. Individuals of this stratum tend to put off treatment of any condition until the last possible moment.

3. Hopeless cases are sent into the hospital by the doctors and by families when treatment has become merely a question of proper bed care and operate therapy. This statement is borne out when it is noted that 463 out of 1,098 died in the hospital.

4. There was a lack of "proper follow-up" in the first 9 years of this period. Three hundred and seventeen "unknown" is entirely too great a

It is possible that all of the cases of cancer admitted to the hospital in that period are not included in this number because of an inadequate filing system for the first few years of that interval.

TABLE I

Total number of cases of known malignancies about whom definite information is available	789	Per cent
Total number who died from the disease in the hospital	403	58.68
Total number listed as dead in the City & Bureau of Vital Statistics 4 years after their admission to the hospital	317	40.17
Five year cases of proved malignancy	8	
Doubtful cases presumptively malignant from gross description although there is no actual biopsy or macroscopical record of the result	1	0.14

TABLE II—SOME DETAILS OF THE CASES OF PROVED MALIGNANCY NOW ALIVE

Malignancy of	Color, sex, age on admission	Treatment	Actual number years after treatment	Microscopical diagnosis
Breast	W F 51	Radical operation	7	Adenocarcinoma
Breast	W F 45	Radical operation	11	Adenocarcinoma
Bone (sarcoma)	W F 45	Thigh amputation	12	Round cell sarcoma
Cecum	W M 40	Resection of cecum with lateral anastomosis	5	Adenocarcinoma
Cervix	W F 40	Supravaginal panhysterectomy bilateral S and O	6	Carcinoma simplex
Hypernephroma	W M 39	Nephrectomy	6	Hypernephromata
Stomach	W M 42	Resection of pylorus	7	Adenocarcinoma
Uterus	W F 51	Panhysterectomy	9	Adenocarcinoma uteri

number. An attempt has been made to remedy this by establishing a tumor clinic at the General Hospital Dispensary (1929). This is now in charge of one doctor who is aided by 3 visiting surgeons, Public Health Federation nurses and a part time secretary.

## PART 2

The private records of the senior surgeons of the surgical staff of the Department of the University of Cincinnati (Drs. M. R. Reid and B. N. Carter) were then examined for cases in which operations had been done in Cincinnati prior to 1929.

The actual distribution of cases is shown in Table IV.

**Comment.** Any comparison which one desires to make with these two groups must be done with the utmost caution. In the first place, only two classifications of the private series are large enough to permit an attempt at any evaluation. These are the stomach and the breast cases. But it will be seen from Tables V and VI that the reduction of them to a percentage basis in order to compare them will allow only the former to be

analyzed and even then the number is too small for any satisfactory conclusions.

## SUMMARY

The cases of "5 year cures" which we present are taken from two classifications. One group is from a large series of 789 and has been secured from the records of a large city charity hospital, the other is a small number of 24 and has been taken from the private cases of two general surgeons. We have no great time to elaborate on them. It would seem, however, that one of the chief things now necessary to do and to emphasize is getting the public educated and interested enough in cancer to allow the physician a better chance to be of permanent benefit to his patient. In other words, individuals with cancer should be

TABLE IV—DISTRIBUTION

Cancer location	Total	Living	Died
Breast	9	6	3
Stomach	5	1	4
Thyroid	2	2	0
Rectum	2	0	2
Face—Carcinoma (large basal)	1	0	1
Cervix	1	0	1
Melanoma	2	1	1
Esophagus	1	1	0
Retroperitoneal sarcoma	1	0	1
Total	24	15	9

Small lesions are not included in this list. They would of course increase the living group.

TABLE III—PRIVATE CASES

	Per cent (see Table I)
Total cases of known malignancy about whom information is available	24
Total cases of these malignancies which are known to have lived 5 years or more	11.46
Total cases which are known to have died within 5 years after operation	13.54
<b>Comments.</b> One of the cases which is listed as dead was killed in an accident. On the other hand 1 of the cases recorded as having lived for over 5 years died in the sixth year following her operation while all of the others are at present living and well.	

1 Caution is advised against any pseudo-scientific attempts to evaluate statistics on cancer. 2 Nineteen proved cancer cases which lived 5 or more years following operation are presented

#### CONCLUSIONS

It can be seen at once that this report may be considered from two diametrically opposite viewpoints. The pessimists will point gloomily at the 99 per cent, the optimists will comment on the results of the private group. We are inclined to take our places with the latter, for while it is true that these two series cannot be compared scientifically and biometrically, for the reasons stated, nevertheless these results tend to show what has been known for years—that cancer can be checked in a very considerable percentage of cases if it is treated early enough. Furthermore, it would seem that the personal equation, or rather two personal equations, enter strongly into the whole question. One is the skill of the surgeon, the X-ray man, or the radiologist, the other is the early co-operation of the patient. The average surgeon and radiologist can generally do a good job nowadays if he has a fair chance. It is now up to the patient to do his part, and it is to this end that the public should be educated.

Stomach cases Total number with results known	Alive	Percent age	Dead	Percent age
Private series	5	1	20	4
Hospital series	154	1	06	153
Cincinnati General				90 04
Stomach cases				80

TABLE VI

seen in the operable stage and not at the very end of the ordinary charity patient with this disease is seen entirely too late. In our series, 59 per cent died in the hospital from malignancy and 40 per cent were dead in 4 years after they had left the hospital. It is true that therapy was instituted in many cases in the desperate hope that the unusual and the miraculous would happen. It did not. There are only 8 people with proved cancer of this group who have lived for 5 years. Contrast this with the private cases. Here we find 11 out of 24 were alive for 5 or more years after their operation. It can be seen at once that this report may be considered from two diametrically opposite viewpoints. The pessimists will point gloomily at the 99 per cent, the optimists will comment on the results of the private group. We are inclined to take our places with the latter, for while it is true that these two series cannot be compared scientifically and biometrically, for the reasons stated, nevertheless these results tend to show what has been known for years—that cancer can be checked in a very considerable percentage of cases if it is treated early enough. Furthermore, it would seem that the personal equation, or rather two personal equations, enter strongly into the whole question. One is the skill of the surgeon, the X-ray man, or the radiologist, the other is the early co-operation of the patient. The average surgeon and radiologist can generally do a good job nowadays if he has a fair chance. It is now up to the patient to do his part, and it is to this end that the public should be educated.

Total number of actual cases considered— breast	Actual number of breast cases	Percentage of actual number of total stomach cases	Actual number of total stomach cases	Percent age
Cincinnati General Hospital series	84	10	154	19
Private series	24	37	5	20

TABLE V

FIVE YEAR CURES OF CANCER IN DETROIT HOSPITALS<sup>1</sup>

HARRY C. SALTZSTLIN, M.D., F.A.C.S., DETROIT, MICHIGAN

IN 1927 the Department of Health of Detroit established a cancer division. It functioned (in co operation with the Wayne County Medical Society) as a registry for the cancer cases treated in all the Detroit hospitals.<sup>2</sup> The depression and other causes have curtailed the plans and the work, but the attempt has been made to follow the cases collected in 1927, 1928, and 1929, for 5 years.

Figures collected in this manner from several different hospitals, with varying degrees of interest and changing organizations, are not as accurate as those obtained under the auspices of one hospital and staff. No case was included unless the pathological diagnosis was recorded but these were not rechecked. (Certain stomach cases, where X-ray and clinical examination were conclusive, were accepted.)

<sup>1</sup>Now under the auspices of the Cancer Committee of the Wayne County Medical Society. Dr. O. A. Brines, chairman. This report is published with their approval.

Presented in the symposium "Cancer Is Curable" before the Clinical Congress of the American College of Surgeons, Boston, October 17, 1934.

## FIVE YEAR CURES OF CANCER IN DETROIT HOSPITALS

Organ	Year	Total cases	Dead	Per cent follow up	Lost to follow up	Living 5 years	Per cent living 5 years
Breast	1927 1928 1929	385	233	85	59	93	24.7
Cervix	1928 1929	257	178	82	45	34	13.2
Fundus uteri	1928 1929	84	50	83	10	24	28.6
Stomach	1927 1928 1929	356	351		4	1	0.3
Rectum	1927 1928 1929	86	70		1	6	7.0
Colon—including cecum and sigmoid	1928 1929	90	83		2	5	5.5
Sarcoma						10	

3 giant cell tumors 4 fascicular sarcomata 1 osteogenic sarcoma 1 angiosarcoma 1 sarcoma uteri. Total number treated is not known.

However, for the 3 years and body organs stated, the attempt was made to include all of the cases treated in the 13 hospitals. Several cancers in other body regions have been cured 5 years, but the number is too small and the total number of cases treated not known accurately enough to be of value. The table, therefore, is a fair exhibit of the work from all the general hospitals of a large city. (There were no special cancer institutions or concentration of cases.)

The accompanying table shows that in average circumstances—

1 Many breast, cervix and fundus cases are cured regularly. Cures of breast cancer approach the proportion obtained in the carefully compiled series from large institutions.

2 The 5 year accomplishment in stomach cancer is very small. A few rectum and colon cancers are cured 5 years.

3 A few sarcomata are cured 5 years.

# FIVE YEAR CANCER CURES AT ST LUKE'S HOSPITAL

FRANCIS CARTER WOOD, M D, and BENJAMIN RICE SHORE, M D, F A C S, NEW YORK, NEW YORK

The operations on the patients here recorded were performed in St Luke's Hospital, and histological study of the tumor is available in each case. The slides are on file and many of them have been reviewed for this report. Tumors of questionable malignancy, such as serous papillary cystadenomata of the ovaries and cellular adenomata of the thyroid gland, and patients in whom the duration of life is not accurately known, have been excluded.

Table I shows the sites and character of the growths.

Instead of discussing further these purely statistical results, which differ in no way from those obtained in other hospitals whose surgeons and radiologists are treating cancer patients intelligently and conscientiously, we have selected a few unusual and interesting cases to review.

The first patient had a Grade I squamous cell epithelioma (Fig 1) of the tongue which was cut into for a biopsy specimen, the wound sutured and a month's time allowed to elapse before the remainder of the lesion was removed. A local excision of the primary growth and a dissection of the right submaxillary triangle were done and the patient has remained well for 19 years.



Fig 1 Grade I squamous cell epithelioma of the tongue. Patient well 19 years after local excision and dissection of one submaxillary triangle.

The 333 cases which we wish to report represent the known 5 year survivals of patients whose cancers were histologically verified and who were treated in the surgical wards and radiotherapeutic department at St Luke's Hospital, New York City. Some 110 private patients are included whose histories have been supplied from the personal records of several of the surgeons. All these patients, with a few exceptions, were treated during the 10 year period from 1919, when our follow-up department was begun, to 1929.

The actual number of 5 year survivals is much greater because many favorable cases have been lost to our follow up department. Patients with recurrences, perhaps leading to death, are much more easily followed in a large city than are those who remain well, or who change residence or secure employment in other localities. The ever present suspicious attitude of many clinic patients toward investigators adds to the difficulty of tracing patients in a large community. In New York City great tact and persistence on the part of the surgeons and follow-up nurses are necessary if patients are to be followed for a period of years.

We have found that much use can be made of the radiotherapeutic department in this respect. Patients who sometimes return reluctantly, or not at all, to the regular follow-up clinics for examination, will gladly come to the radiotherapeutic clinic for postoperative treatments. It is easy to gauge the latter to the needs of individual patients and many can be persuaded to return for treatment and observation over a long period of time.

A statistical study of cancer therapy at St Luke's Hospital is not included in the present report. Such a study of 1,000 consecutive patients with cancer admitted to the hospital from July 1, 1923, to January 1, 1927, was made and published several years ago. At that time it was found that only 32 per cent of the patients applying for admission to the hospital had operable growths, and known 5 year cures were obtained in 30 per cent of the operable cases, or only 7.8 per cent of the entire number. It is reasonable to suppose that better end results in cancer therapy depend more on securing patients in the earlier stages of the disease than upon greater refinements in surgical or radiation technique. For the attainment of better results, education—first of the medical profession and second of the laity—appears to be our greatest need today.

Presented in the symposium Cancer Is Curable before the Clinical Congress of the American College of Surgeons, Boston, October 17, 1934.

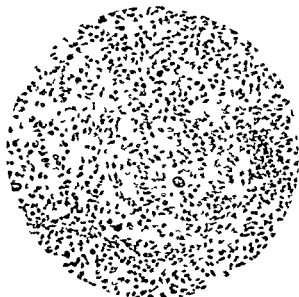


Fig 2 Metastatic melanoma in inguinal nodes from primary tumor on sole of foot

The second patient was operated on by Dr F S Mathews for a malignant hypernephroma of the left kidney. This was a huge growth measuring 21 by 13 by 8 centimeters and the prognosis at the time appeared extremely unfavorable. This patient is now entirely well and free of symptoms 7 years after the nephrectomy.

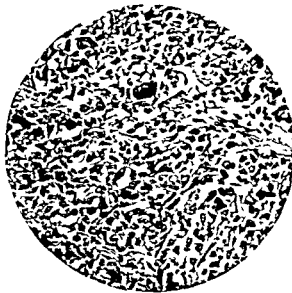


Fig 3 Metastatic melanoma in skin of back. (Same patient as in Fig 2.) Well 15 years after local excision of the primary and metastatic growths by Dr William A. Downes.

TABLE I—FIVE YEAR SURVIVALS OF CANCER PATIENTS

Carcinomata	
Breast	167
Rectum	20
Body of uterus (all operated upon)	19
Cervix uteri (14 operated upon)	
( 5 radium and biop 3 )	19
Colon	11
Stomach	12
Lips	11
Ovaries and tubes	7
Buccal cavity	6
Tongue	5
Skin—squamous	5
Skin—basal	5
Vulva	4
Parotid	3
Penis	2
Melanomata	2
Testicle	1
Thyroid	1
Jejunum	1
Gall bladder	1
Branchiogenetic	1
Hypernephroma of kidney	1
	<hr/> 310
Sarcomata	
of soft parts	8
of bone	4
Uterine myosarcomata	4
Retroperitoneal sarcomata	3
Leiomyomata of jejunum	2
Lymphosarcoma of neck	1
Myxosarcoma of back	1
	<hr/> 23
Total	<hr/> 333



Fig 4 Spindle cell sarcoma of the toe. Patient well 20 years after amputation of the toe only





Fig 5 Advanced carcinoma of the breast involving the axillary lymph nodes, fat and fascia. Patient died 7 years after radical mastectomy (Courtesy of Dr John Douglas)

A pigmented nevus on the sole of the foot of the third patient was excised locally by Dr William A Downes. Several months later a large mass of coal-black lymph nodes containing metastatic melanoma was removed from the inguinal region (Fig 2) and 5 months after this a nodule of metastatic tumor (Fig 3) was removed from the left lumbar region. Since that time there has been no evidence of further dissemination of the growth and the patient has remained well for 15 years.

The tumor in the fourth case was a spindle cell sarcoma of the great toe of an adult patient. A biopsy specimen was taken in the clinic and one week later the toe was amputated. The diagnosis of spindle cell sarcoma was made from histological study of the specimens (Fig 4). This patient has remained well for 20 years.

The last patients which we wish to present are 2 of 6 cases of apparently hopelessly advanced carcinoma of the breast which have survived for over 5 years after what at the time were



Fig 6 Advanced carcinoma originating in the axillary tail of the breast. Axillary nodes extensively involved. Patient well 8 years after radical mastectomy (Courtesy of Dr M. K. Smith)

thought to be purely palliative radical mastectomies. In both of these instances the primary tumors were large and metastatic cancer was found not only in the axillary lymph nodes but also involving the axillary fat and fascia (Figs 5 and 6).

These cases have been reviewed to show that neither the histological nor clinical grading of tumors can be relied upon for the correct prognosis in the individual case and that to obtain the best results in cancer therapy all growths, no matter how advanced, must be treated in a thorough and intelligent manner. The biology of the patient and the biology of the tumor which he harbors are the two great unknowns present in every case of cancer.

CANCER OF THE BREAST IS CURABLE<sup>1</sup>

THOMAS A. SHALLOW M.D., F.A.C.S. PHILADELPHIA, PENNSYLVANIA

WHEN one considers the statistics of the past 30 years, one must admit that cancer of the breast is a curable condition. This conclusion is reached after a careful summing up of the reported cases of malignancy of the breast in which the patients have remained well beyond the 10 year period even when they came to the operating table under the most adverse circumstances. One would naturally conclude that, in the average case which comes to the operating table, the growth has existed from between 6 and 12 months, and in 75 per cent of the cases metastasis has involved the adjacent lymphatics, while in over 67 per cent of the cases the skin is adherent to the tumor. In other words a well advanced cancer is the rule rather than the exception when the surgeon first sees it.

The operation for carcinoma of the breast is not attended with any great shock, nor is any vital structure destroyed yet because of its anatomical situation, perfect exposure is possible not only of the involved breast, but also of the adjacent muscles, the fascia and the lymphatics.

Is surgery alone sufficient for the cure of cancer? In this series of cases, surgery has been fortified by postoperative X ray treatment. We have seen beneficial results in 2 cases postoperatively where the carcinoma had spread to the ribs in one patient and to the spine in the other. In both of these patients following intensive X ray treatments, the metastatic areas disappeared and were replaced by what apparently was normal bone structure. In one case the patient is still living 7 years after the beginning of the X ray therapy and the other 12 years after her operation.

We have noted further that in those patients in whom postoperative treatments were faithfully carried out local recurrences and distant recurrences were the exception. But, on the contrary, in those individuals who did not report for postoperative X ray treatment, local recurrences were more common.

The cure of cancer must depend upon its early recognition. This is only possible through intensive propaganda among female patients and the medical practitioners. It has been stated previously that carcinoma is seldom recognized before the sixth month and usually not before the twelfth. This golden period of formation, localizing growth, limited involvement without metas-

tasis, is the ideal time for surgical intervention. Then carcinoma is curable in certainly 70 per cent of the cases.

We cannot blame the medical man for not making an early diagnosis of carcinoma of the breast, particularly when carcinoma is associated with chronic interstitial mastitis. We are told by good authority that a chronic mastitis is very frequently a forerunner of cancer. This statement is disputed by others of equally good authority. What is the medical man to believe? We should teach him that carcinoma of the breast can and does originate in breasts in which there is chronic mastitis. In this series of 100 cases, 32 patients had definite chronic mastitis and the cancer was not recognized because they were told that cancer was never painful until the end. Most of them had consulted physicians and were given some form of glandular therapy with the hope that a cure would be effected.

We have been teaching for so long the characteristic phenomena associated with the well advanced carcinoma that very frequently mistakes are made. In 3 cases that I recall distinctly at this time, younger surgeons in one of the hospitals with which I am associated removed small tumors from the breasts as finishing touches to abdominal operations, believing that they were dealing with benign growths. The pathological reports returned in 2 weeks after the removal of these growths showed cancer in every case. When questioned about his work the surgeon's answer was "I thought it was an area of mastitis." Had a frozen section been made, the true nature of the pathology would have been disclosed and a radical operation would have given us 3 excellent cases for cure.

Tumors of the breast should not be the tail of a kite, such as these 3 cases were, but, on the contrary, they should be considered of the utmost importance from the standpoint of the patient and the preparation of the surgeon for the procedure.

Within recent years the differential diagnosis between cysts and solid tumors has been made possible by Cutler's method of transillumination of the breast. This is indeed a help in separating some of the benign cystic tumors from malignant ones. X ray studies of the breast have added, even more than transillumination, to early diagnosis. Both of these methods, however, should be used to their fullest extent. If the aver-

<sup>1</sup>Presented in the symposium, Cancer Is Curable before the Clinical Congress of the American College of Surgeons, Boston, October 1, 1934.

TABLE III—MARITAL STATUS

Married	Single	Status unknown	Number of cases
84	11	5	

TABLE IV—DURATION OF LIFE IN YEARS AFTER OPERATION

Length of life	Number of cases
13 years or over	1
12 years or over	2
11 years or over	3
10 years or over	5
9 years or over	3
8 years or over	4
7 years or over	4
6 years or over	4
5 years or over	4

involved and before the adjacent lymphatic glands are in

Improvement in prognosis and treatment can be accomplished not only clinically, but by the aid of transillumination and X-ray examination, when the medical man realizes that it is not uncommon for carcinoma to develop in a breast in which there is chronic mastitis. Thirty-two patients out of the series of 100 reported here had had mastitis.

Moreover, progress will occur when we realize that in those patients in whom there is a discharge either of blood or of clear fluid from the nipple the likelihood of carcinoma is about 40 per cent.

## FIVE YEAR CURES OF CANCER OF THE BREAST AND OF MELANOMA

A C SCOTT, Jr., M.D., F.A.C.S., Temple, Texas

It has often been stated in recent years by excellent authorities that the only hope at present for increasing the percentage of cures lies in educating the public to seek treatment earlier, and that very little can be expected from improvement of surgical technique. The impression has been given and is being broadcast that surgery has reached its limit as a curative agent. We disagree with this view.

We are convinced that hot-knife surgical removal offers a 10 to 20 per cent better chance of cure of cancer of the breast, even though metastasis to the axilla may have occurred, than the use of any other curative agent known.

In 1926 I presented a study of 1,000 cases of various types of cancer treated by this method, and on numerous occasions Dr. A. C. Scott, Sr. presented in the 55th annual Congress of the American College of Surgeons Boston October 17, 1924.

Presented in the 55th annual Congress of the American College of Surgeons Boston October 17, 1924.

W E believe that 95 out of every 100 patients with cancer of the breast can be cured today. This statement is based on our experience during the past 15 years in treating 3,167 patients with various types of cancer, and an intensive follow-up study of 236 breast cancer cases treated by hot-knife surgical removal.

The only conditions necessary to obtain this high percentage of cures are first, treatment while the tumor is limited within the breast, and second, complete removal with the hot-loop knife. The ratio of curability of cancer is dependent today upon three known factors: the time after onset when the patient seeks treatment, the curative agent employed, and the degree of malignancy. The first two factors are more or less controllable by the medical profession.

has described the technique of the hot loop-knife operation. In the series of 3,167 cancers treated in our clinic between the years 1918-1933 inclusive, it was the principal remedial agent employed in 86 per cent of the cases. I am not prepared at this time to report the 5 year cures of the entire series, but I will briefly report 2 small 5 year groups of totally different types of cancer treated by this method.

*Cancer of the breast.* The first radical breast amputation and gland dissection performed exclusively with the hot loop-knife was done in our clinic in 1920 and between that time and the end of 1933, 236 similar operations were performed for cancer of the breast. Of this group, only 124 patients have been operated on 5 years or longer, and 58 patients of the entire 5 year group were alive and well at the end of this period.

In this group of 124 patients, 16 had received various types of surgical interference elsewhere before entry and 1 had received extensive X-ray therapy. 107 patients had their primary treatment in our clinic.

In the group receiving primary treatment in our clinic 18 operations were considered palliative because of one or more of the following conditions: chest wall attachment, diffuse skin involvement, fixation of axillary metastasis, indurated cervical glands or probable distant metastases as indicated by X-ray changes of lung, pleura or bone.

Eighty-nine patients were considered operable and potentially curable irrespective of whether or not they had palpable axillary metastases. Eighty-four of this operable group have been traced. Fifty-two patients or 61.9 per cent, were alive and well 5 years or longer.

Fifty-four patients of the operable group had proved axillary gland metastasis. Fifty of these were traced. 24 died of cancer, 4 died of intercurrent disease or other causes. Twenty-two patients or 44 per cent of this group of traced patients were well 5 years later. If the patients who died

of intercurrent disease are eliminated 22 of the 46 traced patients, or 47.8 per cent, lived 5 years.

Thirty-five patients of the operable group had no pathological evidence of regional gland metastasis. Thirty-four of these were traced, 1 died of cancer, 3 died of other known causes. Thirty patients or 88.2 per cent of this group of traced patients were well 5 years. If the patients who died of intercurrent disease are eliminated, 30 of the 31 traced patients, or 96.7 per cent were well 5 years later.

*Malignant melanoma.* Malignant melanoma, variously termed melanosisarcoma, melano-epithelioma, non-melanotic melano-epithelioma, nevocarcinoma, etc., is generally conceded to be one of the most malignant of all types of cancer and almost inevitably fatal. We have operated with the hot loop-knife on 53 patients with this condition in an attempt to cure and have traced 46 of these. Twenty-nine of the traced patients had been operated on 5 years or longer prior to 1934. Although this is a very small series, our results in treating this most malignant and hopeless type of cancer have so startled us that I think they are worthy of presentation.

Of the 29 patients, 11 or 37.9 per cent were alive and well 5 years or longer. Ten of the 29 had regional gland dissections with demonstrable metastasis and 3 patients, or 30 per cent of those with metastases, were alive and well 5 years. Of the 11 five year cures, 4 had Grade II, 6 had Grade III, and 1 had Grade IV malignant melanoma.

#### SUMMARY

A greater number of patients are being cured of cancer today than ever before, alike by radiologists and surgeons, but we are convinced that a still greater percentage of all surface and accessible subsurface cancers can be cured by the more general use of the hot loop-knife for complete removal.

FIVE YEAR CURES OF CANCER OF THE STOMACH<sup>1</sup>

RICHARD LEWISOHN, M.D., F.A.C.S., and SIGMUND MAGE, M.D., F.A.C.S., New York, New York

From the Surgical Service, Mount Sinai Hospital

CANCER of the stomach represents a fatal disease, unless attacked surgically. In contradistinction to cancerous growths in other locations (mouth, skin, uterus), which can be cured by radiotherapy in a large percentage of cases, surgery represents the only possible curative method for gastric carcinoma.

In view of the absolute hopelessness of this disease, unless removed by operation, we agree with Dr. A. Berg, who was in charge of this service until recently, that no attempt should be made to keep the operative mortality for gastric carcinoma at a low level by refusing to subject patients to radical resection who are at the borderline of operability.

The high operative mortality of cancer of the stomach on this service (33 per cent) is undoubtedly due to many daring attempts to remove the carcinoma even in extensive growths with local metastasis, instead of classifying the patients as definitely inoperable.

Six hundred and forty-seven patients with carcinoma of the stomach were admitted to Mount Sinai Hospital between January 1, 1922, and January 1, 1932. Two hundred and sixty-five

conceded that, as a rule, cancer in persons under of age at the time of the operation. It is generally

Only 2 of these patients were below 50 years of age at the time of the operation. In 3 of these cases the operation was performed more than 10 years ago.

We know of 10 cases of carcinoma of the stomach which have been well for 5 years or more following gastric resection (see table). In 3 of these cases the operation was performed more than 10 years ago.

We were able to maintain a complete follow-up on 88 per cent of the cases operated upon between the years 1922 and 1931 inclusive. Our follow-up records on cancer of the stomach previous to 1922 are very incomplete.

Ninety-three radical resections were performed, the remaining 172 cases (65 per cent) were inoperable. The high incidence of inoperability encountered even on this service, which tried to extend the limits of operation as much as possible, re-emphasizes the urgent need for early investigation of indefinite gastric complaints by roent-

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genography.

No	Year	Name	Hospital record	Age	Duration of symptoms	Palpation	Operator	Pathology	Other notes	Duration of cure
1	1916	Felix B.		47-47	50	2 months of symptoms	Negative	Lewiso	Colloid adenocarcinoma	Adherent to pancreas
2	1919	Jacob J.		40-41	63	4 months	Negative	Lewiso	Carcinoma solidum	
3	1922	Jacob H.		40-49	52	6 weeks	Negative	Berg	Sporadic cell carcinoma	Admitted with acute hemorrhage
4	1924	William H.		40-49	55	6-7 years	Small mass	Lewiso	Adenocarcinoma lymph	Admitted with acute hemorrhage
5	1925	Joseph D.		40-22	54	3 months	Movable mass	Berg	Adenocarcinoma lymph	
6	1927	Rose S.		34-22	55	1 year	Negative	Edelman	Adenocarcinoma lymph	Previous admission to medical service 6 months ago
7	1927	Kathleen B.		2 61-24	57	5 years	Negative	Berg	Carcinoma developing on ulcer	
8	1927	Gussie Z.		91-45	52	10 years	Hard irregular mass	Berg	Adenocarcinoma lymph	
9	1929	Eugene I.		9 94-2	43	1 year	Negative	Gertler	Infiltrating adenocarcinoma	
10	1929	Chas. H.		30-45	55	18 years	Negative	Aschner	Adenocarcinoma with lymph node involvement probably on ulcer basis	

Presented to the Symposium: Cancer is Curable by the Clinical Congress of the American College of Surgeons, Boston, October 17, 1934

50 is more malignant and gives a less favorable chance for radical cure than in persons past the fifth decade

Seven patients were males and 3 were females

Gastric symptoms had been present for a year or more in 6 cases. It is often stated, even by experienced practitioners, that abdominal exploration should not be performed if symptoms have persisted over a fairly long period. In this series 6 cases were amenable to radical surgery in spite of the fact that in 2 cases symptoms had been present for 1 year and in 4 cases for a number of years. In those cases in which the symptoms had persisted for 5, 6, 10 and 18 years respectively, the carcinoma probably developed on an old gastric ulcer.

In 7 cases no mass was palpable. 3 cases (30 per cent) could be subjected to gastric resection, in spite of the pre-operative palpatory findings of a hard tumor in the upper abdomen. The dictum that palpable masses definitely indicate inoperability is as much a fallacy as the statement that

absence of a palpable mass excludes a malignancy of the stomach.

In 9 cases the Billroth II method was used and in 1 case a Billroth I. The Billroth II method is preferable in carcinoma of the stomach, as it facilitates a wide resection of the new growth.

It is of great interest to note that the microscopic examination showed lymph node involvement in 4 of these cases. We have always maintained that local metastasis is no contra-indication to radical operation.

Thus in our material about 20 per cent of the resected cases of gastric carcinoma surviving the operation were still perfectly well after 5 years or more. Gastric carcinoma does not offer a hopeless prognosis and under certain conditions has about the same chance for a permanent cure as cancer in some other parts of the body.

For this reason partial or subtotal gastrectomy should be attempted even in extensive involvement of the stomach as the only possible chance for a permanent cure.

bringing the cancer patient to the doctor early, I strongly advise early general examinations, including a careful pelvic examination for every woman. Too often many symptoms are casually dismissed by the patient as "Oh, it's the change of life," and so, during this period, these examinations should be carried out every 6 months. The inherent danger of vaginal discharge, uterine vaginal bleeding, postcoital and postmenopausal bleeding, or abdominal mass, should be brought to the consciousness of every woman, but again I stress the point that only by routine pelvic examinations will early cancer of the cervix

REPORT OF CERVIX CASES 1925 TO 1933	
Cases	257
Married	213
Single	9
Marital status unknown	4
Childbirth	
None	12
1 child each	45
2 children each	30
3 children each	31
4 children each	20
Over 4 children each	16
Unknown	12
Total	155
Bo	
24	

Pathology	Cases	Year	Cases according to year admitted
Pleurom	117	1915	1
Pleurom	117	1916	1
Pleurom	117	1917	1
Pleurom	117	1918	1
Pleurom	117	1919	1
Pleurom	117	1920	1
Pleurom	117	1921	1
Pleurom	117	1922	1
Pleurom	117	1923	1
Pleurom	117	1924	1
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be detected and the probability of cure greatly increased thereby

In reporting our cancer series at Bellevue Hospital, I am presenting the darkest side of the picture, because of the economic status of our patients. This factor in itself bears out the above points. The incidence of cancer of the cervix is much higher in the poorer classes than in the well-to-do, since the early initial symptoms which are given immediate attention by the well-to-do are either overlooked or disregarded by poor overworked women. To illustrate, we have never received a Group I case for treatment. Also in this class of patients we are greatly handicapped by lack of co-operation in the follow up and proper after care. Even with this most discouraging group we have some cures to report. With a higher economic group the cures would be greatly increased, showing what education and early care can accomplish.

At Bellevue Hospital for the past 9 years irradiation has been used exclusively for cancer of the cervix. All cases were biopsied and classi-

fied pathologically. In our experience the pathological findings have not helped us to prognosticate the course of the disease, but they have aided in planning the dosage of radium to be used in any given case. Fistulae did not develop in any of these cases.

#### SUMMARY

Healing the injured cervix by proper postnatal care, is the most important prophylactic measure for cancer of the cervix.

We advise routine thorough cauterization of the endocervical canal and of the retained cervix following supravaginal hysterectomy.

Early cancer of the cervix gives no symptoms. For this reason, periodic general pelvic examinations should be carefully done. By this means it is possible to detect benign cervical lesions, which can then be treated, or to discover an early cancer if present.

The public should be educated as to what symptoms require immediate attention.

There is no cancer age.

Cancer is curable if treated early and properly.

## CANCER OF THE CERVIX<sup>1</sup>

C. JEFF MILLER M.D. F.A.C.S. NEW ORLEANS, LOUISIANA

THE intent of this symposium, as I understand it, is to present incontrovertible proof of the curability of cancer by collecting a large series of cases that have been treated and have remained well and free from active malignancy for more than 5 years. The report must necessarily be brief, and for that reason I have not arranged a statistical study, but will simply present the results as obtained by letters to patients and physicians, in a series of private cases treated prior to 1929. The report is limited to private records because it was impossible to make necessary inquiries and checks of the large amount of material that passed through the wards and clinics of the busy services under my direction in two public institutions. Even the collection of data from private patients proves a tedious task, for, as usual, a great many ignored written requests.

The oldest living case in my series was first treated in 1908. I can definitely report that 42 patients treated between 1908 and 1929 for cancer of the cervix have reported personally, or through their physicians, that they are well. Eight of

these cases were treated by radical hysterectomy between the years 1908 and 1915. After 1915, only 3 radical hysterectomies were performed, as I had become convinced that too much confusion existed as to the clinical classification of early, borderline and advanced cervical cancer, that the primary mortality of the correctly performed radical hysterectomy was too high, and that over 70 per cent of cases applying for treatment had to be thrown into the discard as unsuitable for anything more than palliative measures. After 1915 radium was used in all cases, early and advanced. Of these treated between 1914 and 1929, 34 recently reported that they have remained well. Twelve of this number had X-ray treatment in addition to radium. The cases subjected to combined irradiation were treated between 1922 and 1929, and as a rule were more advanced. The results in this series have convinced me of the advantages of this method. In addition to irradiation, the electrocautery was freely used in removing everted, crumbling cervixes, and Norris' suggestion for separating, raising and packing away the bladder with gauze during the irradiation.



of cervical tissues removed in performing plastic operations is done. Such routine study should be required in all hospitals, as properly performed biopsies are not done as often as their importance justifies. Biopsy should be the rule not only in suspected cancer, but in apparently simple chronic inflammatory lesions and obstetric

The physician must be kept cancer-conscious. For this the Schiller test is excellent. While not a positive test for cancer, it prompts the routine research for malignancy, and materially assists in differentiating other lesions not recognizable by ordinary inspection. It is especially useful in designating tissues to be removed for microscopic study. The same can be said in regard to the colposcope in the diagnosis of suspicious lesions.

It is certainly permissible to question whether the lay education has been as thorough as it might have been. It has been carried far enough to prove its vast possibilities, yet in our large charity hospitals over 20 per cent of cancer patients are dying without having had either surgery or irradiation. The lay press and the radio are co-operative, but we are overlooking the fundamentals of publicity, viz., repetition and persistence. The agencies of publicity should be persistently utilized, not to relate the horrors of cancer, nor to emphasize the number who die from it annually, but to instill hope, and to disseminate knowledge concerning the value of routine health examinations, not, as Lord Moyrhan says, "by scaring people to death, but scaring them into life."

These are commonplace comments, but they are truths worth repeating. "Commonplace after all is exactly what contains the truth that is indispensable" (John Morley).

non (to prevent subsequent complications), was occasionally done. Most of the cases received within one week from 3,000 to 4,000 milligram hours, and subsequent radium exposures were given only for definite reasons. Repeated treatments every 60 or 90 days, as advocated by some clinicians, too often result in failure and other complications to warrant the adoption of this method as routine.

My report is brief but I wish to emphasize one or two features of the cancer problem that are equally as important as presenting a series of cured cases. May I speak briefly of the necessity of creating a different attitude on the part of the physician who is brought in contact with patients *"who seem to indicate the possibility of cancer"*. If cancer is to be detected earlier, this must not be accomplished merely by the ability to recognize cancer, but by appreciating as well the relation of other diseases to malignancy.

Proper prophylaxis of cancer will yield greater salvage of lives than can be obtained by our present available methods of treatment. I further education of the profession is necessary. Finally, since we believe that cancer is originally a local process, are we consistent in teaching that the early signs of cancer of the cervix are bleeding, discharge, and pain? Are we not summarizing as early signs of malignancy the indications of impending death rather than the symptoms of cancer? A new clinical entity must be described to replace the present stereotyped syndrome.

"Cancer does not have a life history of a few months or a year, but is a disease that usually takes several years to run its full course" (McCarty). The word *early*, which we use so freely, must be more clearly defined. Many of the really early cases of cancer of the cervix are found by accident when routine microscopic examination

CANCER OF THE BREAST<sup>1</sup>

W T COUGHLIN M D F A C S, Sr, LOUIS, MISSOURI

IN the city of St. Louis, 10 or 11 persons out of every 100,000 die each year of cancer of the breast. Surgeons' statistics are usually compiled from the cases in the large clinics. Most of us present are more interested in what happens in our individual practices. Every surgeon keeps personal records of his cases, uses the follow up, and from time to time takes stock and knows just how he stands. It isn't always pleasant but it is highly desirable.

Up to 1929 the author treated 104 private patients (and took care of them himself) under the diagnosis of breast tumor. In these the presence of cancer was proved microscopically 63 times (All of these 63 were private patients and all were white females.) Therefore, the benign lesions were 41. Roughly speaking, 2 out of every 5 were benign and 3 out of every 5 were cancer. This is a high percentage of benign tumors. Thirty years ago we taught that at least 4 out of every 5 lumps in a woman's breast were cancer. This was considered a conservative estimate. The difference is due to the propaganda for early diagnosis. Through our propaganda, at last the laity is beginning to know the truth about cancer of the breast (as through the long years the surgeons have taught them of appendicitis), namely, that in early operation lies the best hope of cure, and that, in fact, no other treatment up to the present in any way approaches in its results those obtained by early and efficient operation. When all physicians believe this truth—that any lump must be removed and examined microscopically in order to be sure that it is *not* cancer—the laity will soon learn it.

We have 63 cases for study. Of the 63 coming to operation, there were still living at the end of 5 years, 29 patients. Six of the 63 had died in the hospital. Twenty two of the 63 died of cancer within 5 years—11 within 1 year, 8 within 2 years, 1 within 3 years, and 4 within 4 years. Two are positively known to have died of other causes within 3 years—1 of pneumonia and 1 of an acute heart attack. Four could not be traced.

Our total number of cases living 5 years after operation was 29, or 46 per cent. Of these 29, 4 died later of metastatic carcinoma, 1 patient being free of any recurrence for 8 years and then dying of cancer of the fourth lumbar vertebra, proved at autopsy to be breast carcinoma, another one, having had a scirrhous cancer with implanta-

tion in the axillary glands, lived free from recurrence for 8 years and then died of cancer of the uterus, another lived free of recurrence and then died 6 years after operation with symptoms of spinal cord tumor—most likely carcinoma of the vertebrae, another died  $5\frac{1}{2}$  years after operation of metastatic cancer of lungs and bones. Of the 29, 1 lived free of symptoms for 10 years and then came with a recurrent nodule in the scar, another comes 6 years after operation with destruction of the twelfth dorsal vertebra.

Of those who died early, the average pre operative duration of the disease was 19 months. Of those who lived 5 years or longer, it was 13 months. Of the 29 who lived 5 years or longer, 5 were known to have had cancer in the glands. Of the 22 who died early, 16 were known to have had cancer in the glands of the axilla or neck. Of the 63 proved cases of cancer, 29 had nursed babies. In the 29 five year cures, 13 had nursed babies. Of the 22 who died early, 11 had nursed babies.

With regard to heredity, the statistics do not mean much. People deny cancer in the family just as they deny insanity, so that the statements of the patient in the negative cannot be accepted without question. There were only 8 of the 63 patients who acknowledged cancer in the immediate family—father, mother, brother or sister. Of these, 7 lived 5 years and the other one could not be traced.

Of the 63 cases, there were 31 involving the right breast, 29 involving the left breast and 3 involving both breasts. Of the 29 five year cures 11 involved the right breast, 15 the left breast and 3 involved both breasts. Of the 22 early deaths, 15 were of the right breast and 7 were of the left.

At the present time the exact status of chronic cystic mastitis is very much discussed. In our series of 104 that diagnosis was made altogether 23 times, and 9 times out of these 23 it was associated with cancer of the breast. One case in which frozen section diagnosis was questionable, and in which breast and lower glands were removed, after 6 years has developed a destructive process in the twelfth dorsal vertebra and is still living. Another one in whom the diagnosis "chronic cystic mastitis" was returned without question and in whom a similar operation was done, returned the next year with a nodule in the

<sup>1</sup>Presented in the symposium, Cancer Is Curable before the Clinical Congress of the American College of Surgeons, Boston October 17 1934.

4 were called medullary carcinoma  
1 was called colloid carcinoma  
1 was called duct carcinoma  
1 the type was not mentioned

Of the 22 who died early—

7 were called scirrhus carcinoma  
4 were called medullary carcinoma  
4 were called adenocarcinoma simplex

2 were called adenocarcinoma  
1 was called basal cell type carcinoma  
1 was called spheroidal cell carcinoma  
1 was called sarcoma round and spindle cell  
2 the type was not mentioned

breast region which was pronounced by the same pathologist "scirrhus carcinoma of the breast" Nine out of 23 cases of chronic cystic mastitis had microscopically proved carcinoma  
There are 8 different cell types named. There is no unanimity among the pathologists with regard to terminology. Of the 29 who lived 5 years or longer—

9 were called adenocarcinoma  
8 were called scirrhus carcinoma  
5 were called carcinoma simplex

CANCER OF THE BREAST IS CURABLE<sup>1</sup>

HUBERT A. ROYSTER MD F.A.C.S. RALIGH, NORTH CAROLINA

CANCER is a symptomless disease. There are no pathognomonic signs of its presence in any organ or tissue. It may exist in the internal organs for a comparatively long time without a disturbance of function or a suspicion of its presence. In its late hopeless stages cancer of any part of the body exhibits pain, ulceration, discharge and cachexia, but these are not symptoms of cancer; they are signs of impending death.

The female breast should be one of the locations in which cancer is recognized early for the breast is exposed to observation both of patient and physician. Unfortunately, the woman frequently fails to notice changes in the contour of the breast and as pain is virtually never felt in the early stages of malignant disease her attention is seldom called to the occurrence of a tumor of this type until it is far advanced. On the contrary, early pain is present in tumors which are benign and these are recognized much more promptly. Actually I believe that thanks to wide spread publicity and educational efforts we are observing as many benign as malignant growths of the female breast if not more in the past 10 years. This is real progress. All our experience all our diagnostic judgment applied to the decision as to whether a given tumor of the breast is benign or malignant can be laid aside in the face of one issue—the presence of any growth in the breast is the reason for its removal. Women generally must be taught a safe slogan: an empty house is better than a poor tenant—remove that lump.

These preliminary observations point the way to two facts upon which the cure of cancer of the breast depends: (1) securing the patient before metastasis has taken place and (2) thorough surgical removal of all involved tissues. The question of employing radiation in any form, either before or after operation is of importance but radiation should be considered only as an aid in the cases suitable for operative interference. Personally I have depended upon postoperative in preference to pre-operative, radiation. This procedure is of course open to argument. Every surgeon must follow his own predilections founded upon individual experience. I have always been afraid that, if I relied too much on what the radiologist could accomplish before operation, I might be tempted to do a less radical removal of the cancer and its surrounding areas. At any

rate, although for chosen patients I use radiation beforehand, in some cases I have felt disappointed in the results and in others I have failed to see the necessity for its use, and still I have looked upon proper postoperative radiation as a ready resource whenever a complete operation may have failed. The use of pre-operative radiation might likewise be considered useful, but in a few of the cases that received prolonged treatment by X ray, the skin and deeper areas were profoundly indurated, offering difficulties at operation, one case exhibited severe and almost uncontrollable oozing. Be that as it may, my object in referring to these methods is to emphasize my belief that any mammary cancer in the curable stage should be totally extirpated by a surgical operation done in the most adequate and finished manner possible. Methods of palliation or those used to prolong life over a certain period form no part of this discourse.

I wish to mention briefly and without tedious tabulation that I have records of 58 personal cases of cancer of the breast among those operated on from 1911 to 1939 all of whom lived beyond 5 years and some of whom are now living and well after 20 years. I have eliminated all who died from any cause whatever within 5 years after the operation although I know that some of these did not die of cancer. The total number of operations (196) is unimportant, as I take it we are concerned here with reporting all our cured cases irrespective of percentages. Many of the cases as far back as 30 years ago were really inoperable but their breasts were removed to obviate local recurrence or for cosmetic purposes. At that time patients did not come so early, neither did we have improved radiology to help us. In point of time the first case of the series dates back to 1911 the patient was then aged 67 and lived about 15 years. The oldest patient was 70 years of age, operated upon in 1914 and died in 1934 of pneumonia with pleural effusion. The youngest patient, 25 years of age, operated on in 1915, is still living and well. Forty of the patients were white and 18 colored. The last patient included in the report was operated on February 20, 1939, and is now without recurrence. Less than half of all the patients received no radiation treatment. For the past 10 years practically every one had postoperative X ray therapy, a few were radiated pre-operatively as well. Of the 58 patients fol-

<sup>1</sup>Presented in the symposium, Cancer Is Curable before the Clinical Congress of the American College of Surgeons, Boston, October 1, 1934.

grading. But I am equally conscious that here are all but a half-hundred women who have lived out their expectancy as a result of the surgical which they would eventually have died, if this dread disease had not been recognized in time. Failures there were, many failures, not only in the successful instances of which all of us have a goodly number. These are the cases to stress in our endeavor to prove that, taken in time, cancer is curable.

followed up to date and here reported as 5 year cures, 6 are considered to have died of metastasis after 5 years, and 3 died of what appeared to be some form of malignancy after 10 years. The remainder, 49 in number, are either alive without recurrence or died of some intercurrent disease not connected with their breast cancers long after the limit of cure. I am aware that this report sets no notable example. I am aware, also, that the survivors represent the most favorable types of breast malignancy, both from the clinical aspects and from what we would now regard as pathological

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<sup>1</sup>Presented in the symposium, Cancer Is Curable before the Clinical Congress of the American College of Surgeons, Boston, October 17, 1934.

# PRIMARY CANCER OF THE VULVA, VAGINA AND FEMALE URETHRA FIVE RESULTS\*

FREDERICK J. TAUSSIG, M.D., F.A.C.S., St. Louis, Missouri

BEFORE proceeding to the body of this paper, may I continue briefly the 5 year statistics on cervical cancer reported at the Congress last year from the Barnard Free Skin and Cancer Hospital where Dr. Gellhorn and I have worked in alternate services for the past 28 years. To the 64 cures out of 566 cases (a percentage of 11.3%) can be added 52 cases from the year 1928-29, with 12 cures. This makes a total of 615 cases with 75 cures, thus increasing the total percentage of cures to 12.3. Our operative results have been so much better than our radium results on early cases that I wish to endorse Dr. Gellhorn's statement of last year urging the retention of surgery in our armamentarium for the treatment of cervical cancer.

Primary cancer of the vagina is very rare and almost universally fatal. Out of a total of 27 cases which were observed previous to October, 1929, at the Barnard Free Skin and Cancer Hospital, only 2 survived for more than 5 years, both were early cases treated with radium. This makes the percentage of cures only 7.5. Many were too far advanced for treatment or refused treatment, so that radium was used in only 18 cases. We acknowledge our total inability to do anything effective for primary cancer of the vagina. Radical operation was done in one recent case with prompt recurrence.

Cancer of the female urethra is somewhat more encouraging. Taking only the 5 year cases at the Barnard Hospital and including 3 of my private cases I can report 14 patients with urethral carcinoma, of whom 4 survived the 5 year period of observation. Of these 4 cured cases, 1 is living and well now for 11 years, 1 died of heart disease at the age of 84, 11 years after treatment, 1 died of breast cancer 8 years later without local

Treatment		Number	Cured (5 years)	Total (5 year cures)	%
Radical	1	1	1	1	100
Local operation	1	1	1	1	100
Local excision of radiation with	3	3	0	3	0
Unradical	2	2	0	2	0
Total	7	7	3	7	42.85

TABLE I—CANCER OF THE FEMALE URETHRA 1906-1929

TABLE II—CANCER

Treatment		Number	Cured (5 years)	Total (5 year cures)	%
Radical	1	1	1	1	100
Local operation	1	1	1	1	100
Local excision of radiation with	3	3	0	3	0
Unradical	2	2	0	2	0
Total	7	7	3	7	42.85

In spite of the fact that patients with cancer of the vulva and urethra. Out of 77 cases of the past 15 years, 13 were cured between 50 and 70%, was 59 years, with the great decade between 50 and 70%, encouraging. Taking only the 5 year cases at the Barnard Hospital and including 3 of my private cases I can report 14 patients with urethral carcinoma, of whom 4 survived the 5 year period of observation. Of these 4 cured cases, 1 is living and well now for 11 years, 1 died of heart disease at the age of 84, 11 years after treatment, 1 died of breast cancer 8 years later without local

including vulvectomy, there were only 2 post operative deaths (5.2 per cent), 1 death on the eighth day from heart failure and 1 on the twelfth day from cerebral embolism (Table III). In spite of many cases of infected wounds there were no deaths from sepsis. No fatalities from hemorrhage or operative shock were noted in this series, in spite of the long operations and proximity to the large vessels of the groin. I consider the Basset lymph gland resection a safe operation provided the surgeon has had a little training for it. My modification of Basset's original technique has been fully described in Curtis *Obstetrics and Gynecology* (Vol. 2). The essential features of this operation consist of laying open the entire inguinal canal, ligating the deep epigastric vessels and removing the deep glands situated to either side of the external iliac vessels. Then the superficial inguinal and femoral glands are freed *en masse* including all tissue and glands in Scarpa's triangle up to the femoral ring. By cutting Poupart's ligament better access is often obtained for the removal of the gland of Cloquet which is situated deeply beside the femoral vessels.

This operation is by no means limited to early cancers of the vulva. The contra indications are only (1) extension to the vagina (2) large lymph glands adherent to the femoral vessels, (3) extreme old age or debility. In the last named group a simple vulvectomy must suffice. Counting only the cases on my own service seen in the past 10 years I have done a complete Basset and vulvectomy on 24 out of 34 cases, an operability of over 70 per cent. In 2 additional cases a Basset was begun but could not be completed because of densely adherent lymph glands. It is evident therefore that I have not been selecting early cases. Assuredly it is encouraging if with an

TABLE III—BASSET OPERATION

	Total cases (1906-1934)			5 year cases (1906-1930 Oct)		
	Number	Operative deaths	Cancer in glands	Number	Cancer in lymph glands	Well over 5 years
Carcinoma of urethra	5	0	1	3	1	3
Carcinoma of vulva	33	2	22	19	12	12
Total	38	2 (5.2%)	23	22	13	15

operability of 70 per cent I have succeeded in obtaining 5 year cures in over 63 per cent.

The rationale of this method of treating cancer of the vulva is further supported by the microscopic examination of the removed lymph glands. Out of the 19 Basset operations done over 5 years ago cancer was found present in the lymph glands 13 times and yet in 6 of these there was no recurrence during the 5 year period. All of the 6 earlier cases without detectable gland involvement remained free of recurrence. Including the 14 cases of Basset operation done since 1929 we have a total of 33 with cancer present in the tributary lymph glands 22 times, or exactly two thirds of the cases. The failure of X-ray or radium to produce more than temporary regressions in such cancerous glands has been amply demonstrated by past experiences. Radical surgical gland removal, therefore, would seem to be positively indicated except in the presence of definite operative contra indications. Finally I should like to stress that absence of palpable glands does not mean absence of cancer any more than the presence of numerous large hard lymph nodes necessarily signifies that these contain cancer metastases.



# SOME REMARKS ON FIVE YEAR CURES IN MALIGNANT TUMORS<sup>1</sup>

EDWIN BEER, M.D., F.A.C.S., NEW YORK, NEW YORK

6 A number of cases of infiltrating carcinoma of the bladder, 11 to 13 years after operation,  
7 A carcinoma of the tongue, 15 years after the first operation

I have been asked to furnish this symposium with my results, especially in bladder and kidney neoplasms, and have recently reviewed the 5 year cures for this occasion. What the exact value of a review and enumeration of disconnected cases is, I cannot quite grasp. We know that we can cure a certain number of carcinoma cases. The patient, however, wishes to know what his chance of a 5 year cure is, and there we are likely to stumble in the individual case, despite studies in microscopical grading and macroscopical determination of radio sensitivity, it is practically impossible to tell the individual patient what his chances are, even if we are lucky enough to get the case early. In general we can say that the earlier we get the cases, the better the outlook, and therefore the profession should aim at early diagnosis. Even advanced cases, however, may be cured, and should be given the chance a valuable contribution would be the determination of the percentage of cases in certain groups, as they come to operation, that are cured for 5 years or more, rather than an enumeration of so many individual cases of a type of malignancy cured for 5 years or more by one or more surgeons. In my subsequent analysis, I have attempted this

As a result of attempts at grading bladder tumors, considerable confusion has been introduced into the study of end-results of therapy. I can see no adequate excuse for so dividing the epithelial growths developing in the bladder that benign papillomata are interpreted as epithelial carcinoma Grade I, and in this report I have excluded all such papillomata, representing some 248 cases, from my discussion. In these so called Grade I carcinomata, my results with transurethral electrocoagulation have been curative in the great majority of cases. However, the results obtained in papillary carcinomata, with and without infiltration of the bladder wall, and solid carcinomata, infiltrating, ulcerating, nodular and more or less papillary, treated by various forms of therapy, fit properly into this symposium. These cases represent the real epithelial malignancies of the bladder, and present one of the major practical problems of the day. A variety of therapeutical efforts has been applied to these

ALTHOUGH there is no doubt that various types of malignant tumors can be surgically removed and the host survive without any evidence of local or distant recurrence, it is impossible to be sure that the patient is not harboring an unrecognized deposit. The peculiarities in the biology of malignant cells—whether they arise from normal cells by a process of localized natural selection or by mutation—do not sufficiently well understood to help us in determining when a patient is really cured. No test for the presence of residual growths is known, except possibly the prolan determination in testicular neoplasms and chorio-epitheliomata. There is no doubt that secondary and even local deposits of cancer cells remain dormant for years, only to spring suddenly into active growth and lead to a fatal outcome. Years ago S. Ober<sup>2</sup> reported such a striking dormancy in a melanosisarcoma of the choroid, which was treated by enucleation. Twenty-four years later the patient developed signs of myelitis and at autopsy showed melanosisarcoma of lungs, heart, liver and first dorsal vertebra. All of us have seen analogous cases, even though the period of dormancy may not have been so long.

As yet we do not know whether this peculiar behavior is intrinsic in the cancer cells, or whether it is due to some inhibitive influence exerted by the host. Moreover, in these unusual cases, we do not know what the life history would have been if the original growth had not been removed, though clinical experience suggests that as a practical proposition excision of the primary deposit should be axiomatic. Having acted on this axiom many years ago, during recent months I have seen or heard from a number of patients that are well after radical operations for a variety of malignant conditions, e.g., 1 A Wilms tumor of the kidney in an adult, 19 years after operation,  
2 A colloid carcinoma of the stomach, 15 years after operation,  
3 A carcinoma of the rectum, 12 years after operation,  
4 A carcinoma of the testis, 17 years after operation,  
5 A carcinoma of the breast, 14 years after operation,  
Zentralbl f Chir 1906 p 509  
<sup>1</sup>Presented in the Symposium "Cancer Is Curable before the Clinical Congress of the American College of Surgeons Boston October 17 1934

cases, and limiting myself to cases treated or operated upon prior to 1930 I find that we have the following results

1 Non infiltrating carcinomata, 11 cases cured by transurethral fulguration or electrocoagulation with high frequency current, representing 55 per cent of total so treated and not lost to follow up

2 Non infiltrating or moderately infiltrating, papillary carcinomata, 4 cases cured by transurethral radium, usually with electrocoagulation, representing 11 per cent of the total so treated and not lost to follow up

3 Infiltrating, papillary carcinomata involving the bladder wall more or less diffusely, 10 cases cured by operative excision according to the technique described by me in 1917<sup>1,2,3</sup> representing 55 per cent of the total so treated and surviving the operation and not lost to follow up

4 Infiltrating, solid, ulcerating, more or less papillary carcinomata, diffusely involving the bladder wall, 14 cases cured by extensive resections, frequently with reimplantation of the ureter, according to the above mentioned technique, representing 40 per cent of the total so treated and surviving the operation and not lost to follow up

5 Infiltrating, solid, ulcerating, more or less papillary carcinomata, diffusely involving the bladder wall, 2 cases cured by suprapubic cystostomy and implantation of radium emanation seeds, representing 10 per cent of the total so treated and surviving the operation and not lost to follow up

6 Very extensive, solid, ulcerating, more or less papillary carcinomata, diffusely involving the bladder wall, 4 cases cured by total cystectomy, representing 57 per cent of the total so treated and surviving the operation

With cauterization, diathermy or electric cautery, or Paquelin cautery, and deep X ray, there have been no 5 year cures in carcinomata infiltrating more or less diffusely the bladder wall

In summary, therefore, in these 6 groups of definite carcinomata, I can report 45 cures in

cases treated prior to 1930. It must be borne in mind that owing to the advanced age of many of these patients when they present themselves for treatment, their life expectancy scarcely warrants a 5 year survival, and many more cases were apparently cured in each category for periods of less than 5 years, but sufficiently long to consider cured

The results in kidney malignancies must be divided into two categories, (1) the hypernephroma or clear cell carcinomata, the adenocarcinomata, the papillary and squamous cell carcinomata in adults, and (2) the embryomata, Wilms tumors and sarcomata usually seen in childhood

In children prior to 1930, in Wilms tumors or embryomata we have no 5 year cures. It is hoped that pre-operative radiation followed by nephrectomy may improve our results. One case of hypernephroma in a child, however, was cured for over 5 years, giving in this group of 7 nephrectomies only 16.66 per cent cures. In view of the fact that all kidney tumors in children are not necessarily embryomata, and in view of the fact that embryomata may vary in their malignancy, the operative removal of such tumors should be regularly carried out.

In adults prior to 1930, we have 7 five year cures in kidney tumors of the hypernephroma and adenocarcinoma and papillary carcinoma type, 1 five year cure in a large embryoma or Wilms type and 1 five year cure in a carcinoma of the ureter, or 9 cases in all out of 34 surviving the operation and followed, making 26 per cent plus

In concluding, it must be emphasized that in view of the fact that the postoperative follow up of the whole series of kidney tumors has been incomplete, the percentage of 5 year cures based on survival after operation and 5 year follow up may represent a maximum percentage of cures whereas in bladder tumors, when repeated cystoscopic check up (usually disagreeable to the patient) is possible, it probably represents a minimum percentage of cures. These patients after several negative cystoscopies tend to be chary and refuse check up (and thus applies to doctors as well as other patients) in this way diminishing the number of 5 year cures

<sup>1</sup>Surg. Gynec. & Obst. 1917 24 645-647 (Read at the Clinical Congress of Surgeons of North America Philadelphia October 23-26 1916)

<sup>2</sup>J. Am. M. Ass. 1917 68 680-682

<sup>3</sup>Ann. Surg. 1921 73 72-76

# FIVE YEAR CURES OF CANCER OF THE RECTUM BY THE RADICAL ABDOMINOPERINEAL EXCISION!

A LAWRENCE ABEL, M S (Lond), F R C S (Eng), LONDON, ENGLAND

Late Hunterian Professor Royal College of Surgeons of England Surgeon attached to the Staff of the Cancer Hospital (the Gordon Hospital) for Rectal Diseases the Princess Beatrice Hospital the Woolwich Memorial Hospital

THE cure of cancer of the rectum depends upon three main factors (1) the knowledge of the pathological paths along which the growth spreads, (2) the planning of an operation to include as much as possible of the fields of spread, (3) careful pre-operative, operative, and postoperative treatment

1 The way in which cancer of the rectum spreads is too well known to need repetition here, except to remind ourselves that it occurs (a) in a downward direction to the ischio-rectal fossa, (b) in a lateral direction on the levatores ani muscles, and (c) most important of all, in an upward direction along the course of the inferior mesenteric artery, and thence laterally toward the wall of the pelvic colon

2 Three main principles of surgery are involved in operating upon cancer of the rectum (1) Not only the growth but also all removable fields of lymphatic spread must be extirpated as widely as possible In this instance the upward spread demands the most careful attention, and should be removed just up to the point where the left colic artery arises from the inferior mesenteric artery (2) Where an operation involves two different fields of management of which one is sterile and the other relatively infected, the aseptic field should first be dealt with and closed off, and the infected area should be dealt with last, in order that the former may not be infected from it (3) Before a primary growth is tampered with or manipulated in any way, the blood and lymph vessels, which are liable to transmit metastatic cells into the venous and lymphatic circulations, should be ligated Primary dissection should be carried out as far as possible from the original growth

The only operation which fulfils these fundamental principles is the radical abdominoperineal excision introduced in 1907 by my friend and senior colleague, Mr W Ernest Miles

3 Pre-operative, operative and postoperative treatment measures are followed (1) Care is taken to ensure that the patient's general health, blood pressure, pulse pressure, and cardiac functions, are gathered with renal and other vital functions, are satisfactory (2) Dehydration is combated, and

no purgation is allowed for 48 hours before operation (3) Careful attention is paid to the state of the patient's bowels and any suspicion of obstruction is treated by performing a caecostomy or colostomy some days before the radical operation, in other cases a 5 to 7 day course of careful colon wash-outs is carried out (4) Any lack of haemoglobin or erythrocytes is combated by a preliminary blood transfusion (5) Careful preliminary pantopon and 1/510 grain scopolamine, one hour beforehand

In the operative treatment during operation we find that the use of a spinal injection of 1.500 per centum markedly diminishes shock Either and chloroform are rigorously excluded, and nitrous oxide oxygen is employed as the general anaesthetic

About 10 years ago I introduced a blood transfusion as a regular routine postoperative practice for all cases, and for the last 2 years have, in addition, been giving continuous intravenous infusion with glucose saline for the first 24 hours, and sometimes longer, after the operation, and meanwhile all fluids by mouth are withheld

In my opinion the most important new lines in technique have been (1) the routine use of spinal anaesthesia, (2) the employment of nitrous oxide oxygen, (3) careful pre-operative care of the intestine, (4) pre-operative building up of natural reserves, (5) absolute aseptic intestinal division, (6) presacral neurectomy, and the avoidance of urinary infection, (7) immediate routine post-operative blood transfusion, (8) continuous intravenous glucose-saline infusion These measures have had a definite influence upon the mortality of the operation, which is steadily improving

Five year cures I have the honor to report on 164 survivors after this operation, operated on by the staff of the Cancer Hospital, London, during the 20 year period 1920 to 1939 inclusive

You have asked me to analyze my cases on a pathological basis and under the following headings (1) incipient, cancer (localized) without gland involvement, (2) cancer that has extended to the lymph nodes, (3) extensive local invasion with metastases, (4) recurrent cancer

As this type of growth in Group 4 is not suitable for rectal diseases the American College of Surgeons Boston October 17, 1934

for the operation it has perforce to be omitted. In 70 of the total series the exact pathological condition is known. These are analyzed in Table I.

TABLE I

	Group	Survivals	Died in less than 5 years	Alive and well after 5 years	Untraced	Percentage of 5 year cures
Rectosigmoid	I	6	1	5		83
	II	5	2	1		33
	III	8	7	1		14
Ampulla	I	2	4	16	2	5
	II	10	2	15	2	9
	III	8	6	1	1	14
Anal canal	I	2	0	2		100
	II	2		0		0
	III					
Total where pathological condition is known		70	24	41	5	58.5

From this the following facts emerge. Early cases without glandular involvement have on the whole a higher 5 year cure rate than the more extensive ones. In the central portion of the

rectum this radical operation is as efficacious in effecting a 5 year cure in those with lymph nodes involved as in those in which lymphatic invasion cannot be demonstrated pathologically.

Of the total series of 164 survivals, 47 cases died within 5 years of the operation, 104 were alive and well 5 years and more after, and 14 are untraced.

TABLE II—COMPLETE SERIES

Survivals	164
Died in less than 5 years	47
Alive and well after 5 years	104
Untraced	14
Percentage of 5 year cures	63.4

Out of all survivals 63.4 per cent were known to be alive and free from signs of the disease 5 years after the operation. If the untraced cases are ignored, 104 out of 150 cases traced represent a 5 year cure rate of 69.3 per cent.

I have to express my thanks to my colleagues, the Staff of the Cancer Hospital, for their kindness in placing their material at my disposal. I also wish to convey to you and the Board of Regents of this illustrious College my heartiest and humblest thanks for the great honor you have done me in asking me to present the results of our work to you today.

MALIGNANT DISEASES OF THE MOUTH, PHARYNX AND LARYNX  
FIVE YEAR CURES!

GORDON B NEW, M D, F A C S, AND FREDERICK A FIGI, M D, F A C S, ROCHESTER, MINNESOTA

Section on Laryngology, Oral and Plastic Surgery, The Mayo Clinic

We are reporting 745 cases of malignant disease of the mouth, pharynx and larynx, in which patients have survived 5

Treatment in the cases has been by surgical operation, depending on the situation of the lesion, type of growth, presence or absence of involvement of lymph nodes, and the patient's age and general condition.

Patients surviving 5 years or more after treatment of a malignant growth of the upper jaw and mandible numbered 127 (2). The primary tumors of the antrum are those that apparently originate in the antrum itself, the secondary tumors of the antrum are those that originate apparently in the upper jaw and extend into the antrum. The tumors of the upper jaw and palate are those which are situated in the regions named without reference to the antrum.

Patients surviving 5 or more years after operation for carcinoma of the lower jaw numbered 60 in these cases the growth was destroyed by surgical diathermy and the submandibular and submaxillary lymph nodes were removed, if the mucous membrane of the cheek or floor of the mouth was involved. In addition to this, radiation was used both locally and externally over the lymph nodes for the neck in the indicated cases. The end-results in these cases are given in Table II.

TABLE I—MALIGNANT GROWTHS OF UPPER JAW AND ANTRUM IN PATIENTS SURVIVING 5 OR MORE YEARS AFTER TREATMENT

Lived 5 or more years after treatment	Situation of growth				Patients treated	Patients treated	Num- ber of treated patients	Per cent
	Anterior primary	Anterior secondary	Upper jaw and palate	Total				
	92	50	154	295	236	127	53 8	
	30	43	118	195	74	62 7		

TABLE II—MALIGNANT GROWTHS OF LOWER JAW 90 PATIENTS SURVIVING 5 OR MORE YEARS AFTER TREATMENT

Lived 5 or more years after operation	Patients operated on	Patients traced	Patients on	Num	Per cent of traced patients
	45	38	11	28	9
	142	113	79	69	9
	187	151	90	59	6
	Total				

TABLE III—EPITHELIOMA OF THE LIP 357 PATIENTS SURVIVING 5 OR MORE YEARS AFTER TREATMENT

Lymphatic involvement, cases	Patients operated on	Patients traced	Lived 5 or more years after operation	
			Number	Per cent of traced patients
Nodes not involved but dissected	253	234	210	89.7
Nodes not involved clinically and not dissected	209	196	119	65.8
Nodes involved and dissected	50	46	18	39.1
Total	547	466	337	75.0

Nodes not dissected because of type of growth, age of patient, and so forth

TABLE IV—EPITHELIOMA OF THE TONGUE 58 PATIENTS SURVIVING 5 OR MORE YEARS AFTER TREATMENT

Lymphatic involvement, cases	Patients operated on	Patients traced	Lived 5 or more years after operation	
			Number	Per cent of traced patients
Nodes not involved but dissected	59	58	29	50.0
Nodes not involved clinically and not dissected	40	36	29	59.8
Nodes involved and dissected	57	56	8	14.3
Extension to floor of mouth	6	6	2	33.3
Total	162	156	58	37.2

Cases in which there was extension to the floor of the mouth not included

†Nodes not dissected because of type of growth, age of patient, and so forth

with the cutting cautery or by diathermy, and this is followed by removal of nodes of the neck. For lesions of a high grade of malignancy, and for lymphosarcomata, radiation is applied by introducing the agent directly into the primary lesion and placing it externally on the neck. For adenocarcinomata of mixed tumor type, the tumor is removed through the pharynx or the side of the neck, depending on where the largest portion presents. In Table V are shown the end results in this group of cases.

Five or more years after operation, 69 patients who had carcinoma of the larynx were surviving (4). For tumors of low grades of malignancy, and in early cases, we perform thyrotomy and remove the growth, destroying the base of it by surgical diathermy. In more advanced cases the cartilage is removed along with the growth. In a small

TABLE V—MALIGNANT GROWTHS OF THE PHARYNX AND TONSIL 44 PATIENTS SURVIVING 5 OR MORE YEARS AFTER TREATMENT

Pathological type	Patients traced	Lived 5 or more years after operation	
		Number	Per cent of traced patients
Squamous cell epithelioma	34	9	26.5
Lymphosarcoma	11	6	54.5
Adenocarcinoma, mixed tumor type	31	29	93.5
Total	66	44	57.9

TABLE VI—CARCINOMA OF THE LARYNX 69 PATIENTS SURVIVING 5 OR MORE YEARS AFTER OPERATION

Operation	Patients traced	Lived 5 or more years after operation	
		Number	Per cent of traced patient
Thyrotomy	34	28	82.3
Laryngectomy	73	41	56.1
Total	107	69	64.5

group of cases in which the anterior commissure is involved, this is removed in one piece after division of the hyoid bone and examination is made through the thyrohyoid membrane. For growths of the epiglottis, preliminary tracheotomy is performed, and the primary lesion is removed by surgical diathermy under suspension. In more advanced cases of tumor of the epiglottis, ary-epiglottic fold, and base of the tongue, pharyngotomy is used. In cases in which there is fixation of one side of the larynx, with involvement of the anterior commissure, and the lesion is of a high grade of malignancy, laryngectomy is performed. Radiation is used before and after treatment of the more malignant lesions. The end results in these cases are shown in Table VI.

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FIVE YEAR SURVIVALS IN LYMPHATIC TUMORS<sup>1</sup>

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Hodgkin's disease, lymphosarcoma, and leucemia by irradiation are few. Some writers doubt that the average duration of life following onset of these diseases can be increased by the use of X-rays or radium. This question because the great variations in duration of the natural course impart the value of averages.

However, the dramatic primary regressions, and the lessening or disappearance of symptoms, that are brought about by irradiation in numerous individual cases, suggest that life has been prolonged in these instances, at least, and fully justify the continued use of X-rays and radium in these fields.

The following four tables show the 5 year survivals in cases of Hodgkin's disease, lymphosarcoma, myeloid leucemia, and lymphatic leucemia.

TABLE I—HODGKIN'S DISEASE—FIVE YEAR SURVIVALS

Excluding cases untreated or lost to follow up within 6 months

All cases	Num ber	Per cent	Average survival —years
125	100	68	100
(excluding 4 cases followed less than 6 months)			
Total 5 year survivals	4	50	6
Alive 5 years on 7-1-34	0	0	0
Alive 5 years and NED on 7-1-34	0	0	0
Longest case 7 4 years			

TABLE II—LYMPHOSARCOMA—FIVE YEAR SURVIVALS

Excluding cases untreated or lost to follow up within 6 months

All cases	Num ber	Per cent	Average survival since admission —years
17	100	19	100
Total 5 year survivals	2*	0	7.5
Alive 5 years on 7-1-34	2*	0	6.5
Alive 5 years and NED on 7-1-34	12	13	5.5
Longest cases 13, 7, 8, 4 and 7 3 years			

TABLE I—HODGKIN'S DISEASE—FIVE YEAR SURVIVALS

Excluding cases untreated or lost to follow up within 6 months

All cases	Num ber	Per cent	Average survival since admission —years
125	100	19	100
(excluding 4 cases followed less than 6 months)			
Total 5 year survivals	13	13	7.5
Alive 5 years on 7-1-34	6	48	8.0
Alive 5 years and NED on 7-1-34	4	32	10.3
6 survived over 7 years Longest survival 13 4 years No evidence of disease			

TABLE II—LYMPHOSARCOMA—FIVE YEAR SURVIVALS

Excluding cases untreated or lost to follow up within 6 months

All cases	Num ber	Per cent	Average survival since admission —years
96	100	14	100
Total 5 year survivals	7	7	7.5
Alive 5 years on 7-1-34	3	3	6.0
Alive 5 years and NED 7-1-34	2	2	7.8
Longest case 10 3 years			

THE SURGICAL TREATMENT OF CANCER OF THE STOMACH<sup>1</sup>

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**A**BOUT one fourth or one third of the 120,000 deaths from cancer every year in the United States is from cancer of the stomach.

There is no real problem as to what the treatment of gastric cancer should be. Practically all malignant tumors of the stomach, except the rare lymphosarcoma and the unusual small round cell carcinoma from the deeper layers of the mucosa, are radioresistant. With improvement in the technique of radiation, doubtless some further beneficial effect can be derived from this source, but with the liver overlying the stomach and the pancreas behind it, an amount of radiation that would materially affect a gastric cancer that is even mildly radioresistant would doubtless play havoc with these two vital organs. We may say, then, that while in some instances radiation is an adjuvant, in the vast majority of cases of cancer of the stomach there is only one remedy, surgical excision, which is remarkably efficient if applied early. Thus, Balfour reports that in his records about 50 per cent of the patients in whom gastric carcinoma confined solely to the walls of the stomach has been widely removed are alive and without recurrence 5 years after operation.

## CLASSIFICATION OF OPERATIONS FOR GASTRIC CANCER

The surgical therapeutics for cancer of the stomach may be divided into 6 different classes, 3 of them with a view to cure, and 3 solely for palliation. The Billroth I operation, the Billroth II operation, and total gastrectomy may be listed as curative operations, while gastro-enterostomy, the Devine operation and gastrostomy are only palliative.

In the first division is cancer of the pyloric end of the stomach in which it is possible to do a reasonably wide resection and then unite the stump of the stomach to the duodenum. Operations which proceed along this line are classified under the title of the Billroth I method, and the various techniques such as the Finney, Haberer and others that accomplish this are termed modifications of the Billroth I.

In the second division are the more extensive cancers of the pyloric portion or of the middle body of the stomach in which it is not possible to bring the stump of the stomach to the duodenum, so the duodenum must be closed and an anasto-

mosis made to some portion of the jejunum. This is known as the Billroth II method of operation, and the various types of it, as the Polya, Hofmeister and Balfour techniques, are called modifications of the Billroth II principle.

In the third division, the stomach is extensively involved without surrounding metastases, or the cardiac portion is affected, and here a total gastrectomy may be indicated. This operation, of course, is applicable to only a comparatively small number of cases.

In certain non-resectable cases of gastric cancer, often some palliative operation is indicated. It is doubtful if gastro-enterostomy has any place in the treatment of cancer of the stomach. It certainly has a very limited field, which is apparently vanishing. If the patient has a large mass in the pyloric end of the stomach and there are a few metastases outside of the stomach or a small metastasis in the liver, doubtless a partial gastrectomy, removing the sloughing septic mass, will make the patient more comfortable and probably give a longer life than a gastro-enterostomy would.

## PREPARATION, ANÆSTHESIA, AND AFTER TREATMENT

The pre-operative and postoperative treatment in all cases of cancer of the stomach is extremely important. Several times a day the patient should have a gastric lavage under low pressure. Dehydration is corrected largely by proctoclysis, hypodermoclysis or the intravenous administration of dextrose in Ringer's solution, which latter procedure we have found particularly satisfactory. Transfusion of blood is often indicated.

Following the suggestion of W. H. Higgins, of the staff of St. Elizabeth's Hospital, we began about 10 years ago giving patients who were to be operated upon for gastric cancer large quantities of dilute hydrochloric acid for several days before the operation. This has a marked antiseptic effect and lessens the danger of peritonitis. Some intraperitoneal vaccine such as that of Steinberg may also be helpful in preventing infection.

The anæsthetic should be carefully chosen. In many cases operations for gastric cancer can be done under local anæsthesia, supplemented if necessary by ethylene or by nitrous oxide and

<sup>1</sup>Presented in the symposium on the Treatment of Cancer before the Clinical Congress of the American College of Surgeons, Boston, October 17, 1934.



The vessels are doubly clamped and divided at the greater curvature. Then the gastrosplenic omentum is doubly clamped and divided in sections toward the pyloric end of the stomach, keeping close to the colon. When the pyloric end of the stomach is reached special care is taken to avoid injury of the mesenteric vessels of the transverse colon. By lifting the stomach well up in this region and by separating any adhesions and pushing down the transverse mesocolon, injury to its vessels can usually be avoided, but it is highly important to remove as much tissue as possible from around the pyloric end of the stomach.

The blood vessels are controlled by transfixing and tying each clamped segment with plain catgut. The ends of some of these ligatures are left long. Two ligatures are placed on the stump of the vessels along the lesser curvature, and the one nearest the point of division is left long. This is to avoid the possibility of the ligature in this region slipping. The portion of the stomach to be resected is thus isolated entirely, except for its continuity with the rest of the stomach and with the duodenum. Two stout Payr clamps are placed on the body of the stomach as close together as possible. Two clamps, preferably pedicle clamps such as the Ochsner or Kelly forceps, are placed on the duodenum just beyond the pylorus. The duodenum is divided between the clamps with the electric cautery, and then the stomach is incised between the two Payr clamps with the electric cautery, taking care to cauterize the stump of the stomach thoroughly so that the Payr clamp is heated sufficiently to char the tissues within its grasp. This not only kills any cancer cells that may be in the grasp of the clamp and so adds somewhat to the chances of cure, but also tends to control bleeding. The stump of the duodenum is brought over to the stump of the stomach and there is not sufficient undersurface of the duodenum exposed, the pancreas is dissected back, preferably with a few light strokes of the electric cautery.

In many instances when the stump of the stomach apparently cannot be brought over to the duodenum, the stomach may be mobilized by slipping the hand under the cardiac end, stretching the greater artery if necessary. Often these manipulations will be so effective that even a small remnant of stomach, which at first it seems impossible to bring over, can be mobilized and sutured to the duodenum without tension.

Beginning at the upper border, a series of interrupted mattress sutures of 00 tanned or chromic

is incised, and the gastrosplenic omentum is selected, division along the lower border of the stomach is pushed up. The proper point of division of the gastrosplenic omentum is marked with the hand, and with the fingers the gastrosplenic omentum is lifted up with the hand, and the stomach is lifted up with the fingers. The stomach is placed in the lesser omentum with safe solution as placed in the lesser omentum to avoid transplanting cancer cells. Gauze moistened with sterile water is placed over the stomach, and as disposed, not only to prevent shock but to avoid transplanting cancer cells. The stomach is lifted up, making all movements as gentle as possible, and the electric cautery is used to divide the electric cautery. The pyloric end of the stomach are similarly treated, divided about its center, and the vessels to the pylorus are doubly clamped and divided, and the gastrosplenic omentum, which is usually quite thin, is doubly clamped and divided. The gastrosplenic omentum, electric cautery. The gastrosplenic omentum, doubly clamped and divided, preferably with the stomach at the proposed point of resection are divided along the lesser curvature of the stomach. The vessels along the lesser curvature of the stomach are divided, and the stomach is brought over to the stump of the duodenum and there is not sufficient undersurface of the duodenum exposed, the pancreas is dissected back, preferably with a few light strokes of the electric cautery.

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MODIFICATION OF BILLROTH I OPERATION

I shall not attempt to describe all of the different operations for cancer of the stomach, but shall only give those that appear to me to be the most satisfactory. Some modification of the Billroth I technique can be applied more frequently than it is used, but metastases of gastric cancer are prone to extend along the lesser curvature of the stomach, and an attempt to make a satisfactory approximation of the stomach to the duodenum should prevent a sufficiently wide excision. The point of resection should be at least 4 centimeters beyond the apparent margin of the cancer. If more of the stomach than this can be removed without impairing the conditions for the operation, it should be done. The first procedure, of the abdominal contents, feeling in the position of the cut-de-sac, and examining the lymph nodes under the diaphragm. If there is no contraindication to a radical operation and a Billroth I type of operation is applicable, the gastrosplenic omentum is opened, the tissue just beneath the posterior peritoneum above the pancreas and up toward the diaphragm on both sides of the spinal column are thoroughly infiltrated with a 5 per cent novocain solution to which has been added about 2 drops of 1-1000 adrenalin solution to the ounce. If the needed just under the peritoneum, no damage to the deeper structures will occur and the solution will infiltrate freely and block off all of the nodes in this region.

catgut is placed, uniting the posterior surface of the stump of the duodenum to the upper portion of the posterior surface of the stump of the stomach. All of these sutures are placed before any one is tied (Fig 1). When they are tied the ends of the upper and of the lower sutures are left long as tractor sutures. The clamp is removed from the stump of the duodenum, and any regurgitant duodenal content is removed with a suction apparatus. Bleeding vessels are clamped with small hæmostats. The Payr clamp on the stump of the stomach is removed, bleeding points are clamped, and the gastric contents are withdrawn with a suction apparatus. The stomach, of course, should have been washed out a short while before the operation. Occasionally in marked pyloric obstruction gastric lavage will not remove all of the contents of the stomach, in some cases I have found food, such as corn or beans, that was eaten several days before. If it is suspected that this may occur, there is placed among the instruments a small soup ladle, with which the contents of the stomach can be ladled out, after which the stomach is cleaned with salt solution. If the surrounding tissues are well protected with moist gauze, and care is used in the lading, but little soiling occurs, and if abundant hydrochloric acid has been given for several days before the operation this material should not be very septic.

No effort is made to trim away the margins of the crushed tissue. A study of the sutured intestine and stomach shows that the margin of the wound always degenerates and tissue that is held by sutures firmly enough to produce complete hæmostasis will slough off, so that trimming away the margins of crushed or charred tissue is of no advantage so far as eventual healing is concerned, causes an additional loss of blood, and unnecessarily exposes fresh surfaces to the contents of the stomach and duodenum.

A suture of No 1 tanned or chromic catgut is begun, going from the mucous membrane on the upper border of the stump of the stomach outward, returning through the upper border of the stump of the duodenum from without inward. This knot is tied several times, and the short end is clamped. If the stump of the stomach is large, its lower portion is clamped with a pedicle forceps. This suture is continued downward as a lock stitch, snugly uniting the posterior margin of the stump of the stomach to the posterior margin of the stump of the duodenum (Fig 2). When the lower border of the duodenum is reached, its anterior wall is incised for  $1\frac{1}{4}$  to  $1\frac{1}{2}$  inches (3 to 4 cm). This incision should be just below the center of the anterior surface of the duodenum,

and its location is accurately ascertained by putting the finger into the duodenum. This incision flares open the duodenum and permits about two more stitches of the continuous lock-stitch, uniting the stomach to the duodenum. Then the suture is continued over the redundant lower portion of the gastric stump and tied at the greater curvature (Fig 3). Occasionally by flaring open the duodenum thus, if the stomach is not large, an end-to-end union can be made but usually there is a redundancy of the stump.

A second suture is begun as the first suture, passing from within outward at the lesser curvature of the stomach and from without inward at the upper border of the duodenum. After tying this suture, its short end is tied several times to the short end of the preceding suture. This makes for additional security. This suture is carried anteriorly as a continuous stitch. Where there are bleeding vessels, an additional loop of the stitch is taken to secure hæmostasis. The suture is placed as far as possible from within, being tightened only on the left side as it emerges from the stump of the duodenum while pressure is made just behind it, as shown in the illustration. In this way not only is hæmostasis secured, which cannot be satisfactorily done by the continuous mattress suture, but the raw margins are inverted almost as though the suture were applied entirely from within (Fig 4). When the lower border of the duodenum is reached, this suture, too, is continued onto the redundant stump of the stomach and terminates at its lower border. A suture of No 00 tanned or chromic catgut is begun as a purse-string suture at the lower border of the stomach, invaginating the redundant teat (Fig 5). It is then carried upward, as a continuous mattress or right angle suture with an occasional backstitch, and terminates at the upper border of the stomach. At this point the ligatures on the vessels at the upper border of the duodenum and on the vessels of the lesser curvature of the stomach are tied together, and over them is inserted a purse-string or a mattress suture of No 00 tanned or chromic catgut, still further invaginating the tissues. This region is particularly subject to peristalsis and traction, and additional suturing here is advisable. At the lower border where the redundant teat of stomach was tucked in, a purse-string suture of No 00 tanned or chromic catgut is placed, and after it is tied the ends are passed through adjacent peritoneal covered fat and are again tied. A few additional interrupted sutures of No 00 tanned or chromic catgut may be placed anteriorly, and if peritoneal covered fat is handy it is also caught in the suture.

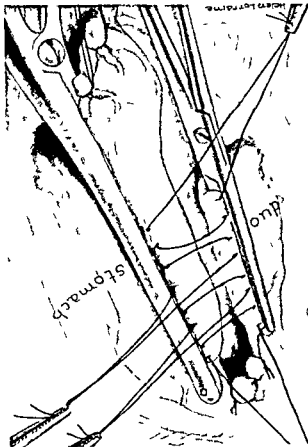
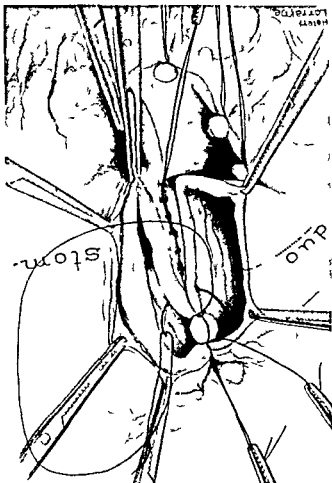


Fig. 1 The segment of the stomach has been removed to the posterior margin of the stump of the stomach is sutured to the posterior margin of the stump of the duodenum, with interrupted mattress sutures of fine tanned or chromic catgut. All of the sutures are placed before any one is tied

This operation I have been doing with much satisfaction for the past 10 years in cancer of the stomach and in ulcers of the pyloric portion of the stomach. Its advantages are that the pathological lesion is excised and the physiological function of the stomach is restored as nearly as possible to normal. The physiologically active lesser curvature of the stomach is joined with the upper border of the duodenum which is its normal relationship. The physiologically inactive greater curvature is easily folded in. The great objection to the original Billroth I operation, the so called "deadly triangle" which occurred when the stump of the duodenum was joined to the greater curvature of the stomach, is avoided. By invaginating the gastric stump along the greater curvature where it is quite mobile, and by bringing over peritoneal covered fat, this region is made secure. Flaming open the duodenum after it has been fixed by sutures does not displace its relationship to the upper border of the stomach and at the same time gives a wide opening which prevents contraction and will doubtless be a sufficient evil for

Fig. 2 The internal row of sutures is being applied, uniting the posterior margin of the stump of the stomach to the posterior margin of the stump of the duodenum. The dotted line shows where the incision will be made in the duodenum to flare it open



food even if recurrence of the cancer makes some obstruction in this region. The field of operation is limited to the vicinity of the lesion and does not involve the possibilities of spreading bacterial infection or cancer cells to the other organs or to tissues below the transverse mesocolon, which might be possible in the types of Billroth II.

It is well known that in many cases of cancer of the stomach there is some free hydrochloric acid in the gastric juice. If there is no free hydrochloric acid at the time of operation, and the patient is cured by removing the cancer, it may be reasonably assumed that the secretion of hydrochloric acid will be resumed in at least some cases. Physiologists have shown that the sensitivity of the intestinal mucosa to hydrochloric acid increases from the duodenum down, and that the duodenum normally has far more resistance to hydrochloric acid than any other portion of the intestinal tract. It is readily conceivable that what not infrequently happens in partial gas-

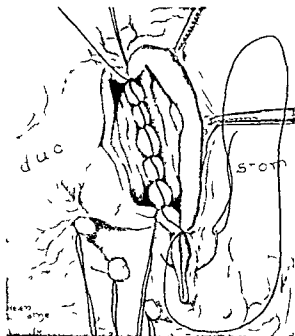


Fig 3 The duodenum has been flared open and the posterior row of sutures is about completed

trectomy for peptic ulcer in which the Billroth II type of operation is done—development of a jejunal ulcer—may occasionally occur in partial gastrectomy for cancer when the Billroth II type is done. Thus, Fordyce B. St. John has reported a case of death from jejunal ulcer which followed some time after a Polya type resection for cancer of the stomach.

The technique described must often be modified to suit the conditions. If, for instance, there are adhesions along the head of the pancreas, it will be best to divide the stomach between the Payr clamps and dissect it toward the pyloric end, preferably with the cautery, and if necessary include a small portion of the pancreas in the dissection. If there seem to be adhesions and special involvement along the lesser curvature, the gastroduodenal omentum should be first opened and then the stomach can be divided between the Payr clamps, the duodenum between clamps, and, finally, the dissection made toward the lesser curvature.

In occasional cases the transverse colon is involved, so in order to maintain the principle of block dissection the gastrohepatic omentum is first divided in segments, the stomach doubly clamped and divided about its middle, and the duodenum also divided. The stomach is then lifted up, the mesocolon is divided in segments, and the regions for section of the transverse colon

are doubly clamped and divided with the cautery, thoroughly charring the stumps. The stomach is then united to the duodenum, as has been described, and, lastly, the stumps of the transverse colon are treated. The kind of treatment depends largely upon the condition of the patient. If the patient is quite fat, or if his condition is not good, it will doubtless be best to bring the stumps of the colon into the wound, leaving the clamps upon them, and to do a right colostomy through a muscle splitting incision, bringing up the first portion of the ascending colon onto the abdominal wall, placing a glass rod beneath it, and then opening the cæcum. This procedure would probably be indicated even with a direct anastomosis of the colon, which may be advisable when the patient is thin with an empty bowel.

The type of operation described has, I think, a far larger field than has been generally credited to it. Undoubtedly, however, there are many cases in which the stump of the stomach cannot be satisfactorily united to the duodenum, and here some type of Billroth II operation should be done.

#### MODIFICATIONS OF BILLROTH II

The most popular type of Billroth II is the Polya operation, in which the jejunum is brought up through a rent in the mesocolon and sutured to the stump of the stomach as an end-to-side union. If it is possible to do so, the anastomosis is drawn down through the rent in the mesocolon, so it lies below the mesocolon and resembles a posterior gastro-enterostomy.

In some instances, when this is difficult, the modification introduced by Balfour is excellent, bringing the jejunum over the colon and suturing it to the stump of the stomach. When this procedure is adopted a long loop of jejunum should be chosen because the oral end of the loop if too short swells and may cause obstruction. An *entero-anastomosis* should be made between the two limbs of jejunum, just below the transverse colon.

The Hofmeister modification of the Billroth II appears to me to be better than the usual Polya. In the Hofmeister operation, which is particularly applicable when the stump of the stomach is very large, the upper portion of the stump is closed by sutures and the lower half or third is left open and anastomosed to the jejunum end-to-side (Fig. 6). In such cases it will be less difficult to bring down the lower portion of the stump of the stomach for the anastomosis than to bring down all of it, as with the Polya operation. One objection to the Hofmeister operation is that if the incision of the

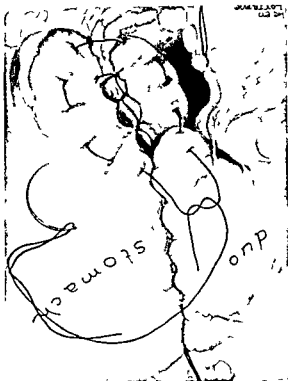


Fig. 5 A purse-string suture of fine tanned or chrome catgut is placed at the lower portion of the stump of the stomach, inverting the redundancy.

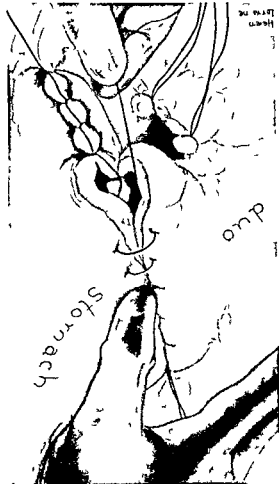


Fig. 4 The anterior row of sutures, which was begun as explained in the text, is continued downward in such a way as to invert the margins of the stomach and duodenum. The suture is drawn taut only as it emerges from the duodenal mucosa, while pressure with the thumb or finger is made on the wound behind the stitch.

attachments to the stomach along the greater and lesser curvatures are severed as in a partial gastrectomy. A rubber catheter is inserted at some portion of the stomach where the wall seems to be normal and fastened with a purse-string suture of linen which also transfixes the catheter. Another purse-string suture burses the catheter still further (Fig. 7A). The catheter is connected at intervals with a suction apparatus and so draws off gas and the fluid contents of the stomach. In this way regurgitation into the oesophagus that might be caused by lifting up the stomach is avoided. This regurgitated fluid may flow back again into the abdomen when the oesophagus is divided. The attachments to the spleen are delicate and must be carefully clamped and divided. Thorough hæmostasis is made. The clamped tissue is controlled by transfixing and tying it with plain catgut. The duodenum is doubly clamped with pedicle clamps and divided with the cautery. The stomach is lifted up, using suction through the catheter at intervals. The stomach thus forms a kind of handle for the oesophagus, a valuable suggestion of Mayo-Robson.

The loop of jejunum for the anastomosis is chosen with special reference to having the oral part of the loop sufficiently long to reach the diaphragm not only without tension, but with a redundant portion of it hanging well below the

gastrectomy is made in such a manner as to leave a marked redundancy along the greater curvature, infolding of the upper portion of the stump may convert the lower portion into a kind of snout and produce occlusion. To avoid this, the incision in the stomach should be made with a distinct slant from the lesser curvature downward and to the left. Even then, if there appears to be too much redundancy, the lower portion of the stump should be cut away.

# TOTAL GASTRECTOMY

While total gastrectomy has a limited field, this field is definite and with improvement in technique, and in the pre-operative and postoperative care of the patient, this operation will be more often indicated. In total gastrectomy infection is more likely to occur than in partial gastrectomy, and drainage should usually be provided. In this operation the

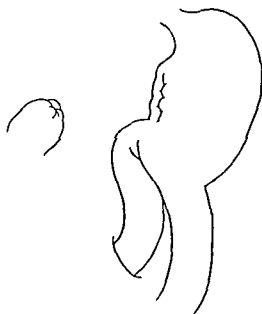


Fig 6 The scheme of the Hofmeister operation a modification of the Billroth II shows the general principles of its technique This is a variation of the Pulya operation In order to prevent confusion the colon is not represented in the sketch but the loop of jejunum is brought up through a rent in the mesocolon The upper part of the stump of the stomach is closed and the anastomosis of the jejunum is made with the lower portion of the stump of the stomach instead of throughout its whole length

transverse colon The part of the loop to be anastomosed is isolated by small rubber bands which are thrust through the mesentery These are superior to clamps and are less in the way An interrupted suture of silk or linen is passed from the upper surface of the side of the jejunum about halfway between the mesenteric and the convex border to the left portion of the posterior surface of the œsophagus The ends are left long A similar suture is inserted between the right border of the œsophagus and the jejunum, leaving space of about  $1\frac{1}{2}$  to  $1\frac{3}{4}$  inches (4 to 4.5 cm) between the two sutures (Fig 7) While these tractor sutures are held taut a continuous suture of silk or linen unites the jejunum to the posterior wall of the œsophagus One end of the tractor suture may be utilized for this suture The suction apparatus is disconnected from the catheter, after the stomach has been thoroughly emptied, and a transverse incision is made in the posterior wall of the œsophagus beginning on the right side An incision is made in the jejunum about  $\frac{1}{4}$  inch (0.6 cm) from the suture line The œsophagus and jejunum should be thoroughly packed around with moist gauze before the sutures are placed and

as soon as the opening into the œsophagus and the jejunum is made the suction apparatus is applied Beginning on the right side a linen or silk suture in a small curved needle unites the posterior margin of the incision in the jejunum to the posterior margin of the incision in the œsophagus The suturing is then continued until the left border of the œsophagus and the left extremity of the incision in the jejunum have been reached The incision in the œsophagus is carried anteriorly, catching the margin of the œsophagus as it is cut in order to prevent retraction The suture is continued around anteriorly, uniting the anterior margin of the wound in the œsophagus to the anterior margin of the wound in the jejunum As far as possible it is well to apply this suture from within, drawing the suture snugly as it emerges from the inner surface of the œsophagus, as has been described in the operation for partial gastrectomy The suture is tied to its original end on the right side The ends of the tractor sutures are cut short

The first row of sutures is again taken up and carried anteriorly as a continuous suture, burying the inner row and is tied to its original end Over this is placed a series of interrupted mattress sutures preferably of No 00 tanned or chromic catgut to give further strength to the union, and particularly reinforcing the two lateral borders If any available peritoneal covered fat is found it should be brought over and caught with the long ends of these mattress sutures

Instead of closing the stump of the duodenum, the right half of the jejunal loop is brought over and sutured to the stump of the duodenum end to side By this procedure several things are accomplished Once I lost a patient after a total gastrectomy because of a volvulus in the loop of jejunum that extended from the entero-anastomosis to the œsophagus By fixing the jejunum to the duodenum this accident can be avoided Second the duodenal contents can readily drain into this loop, if there happens to be some blockage lower down Third, a duodenal fistula is less liable to occur with the easy emptying of the duodenum (Fig 7B)

At a point just below the transverse colon an entero-anastomosis is made between the two loops of jejunum, and about 6 inches farther down a medium sized soft rubber catheter which has been passed through a stab wound to the left of the abdominal incision is introduced obliquely into the jejunum for feeding this is done according to the method of Witzel, or better, according to a modification of the Coffey principle

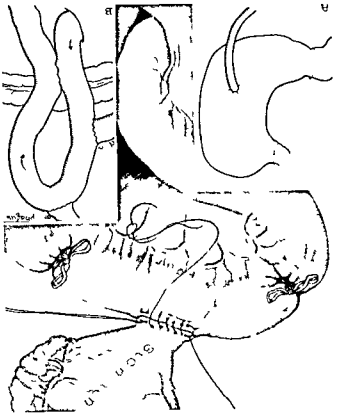


Fig. 7 Total gastrectomy. The stomach has been severed from all of its attachments except the esophagus, and a catheter has been inserted in order to keep the stomach empty. Following the suggestion of Moynihan, the stomach is turned up out of the upper portion of the abdominal wound onto the chest, and is used as a handle for exposing the esophagus. Tractor sutures of silk or linen are inserted at each border of the esophagus, and the jejunum and the esophagus are united with a continuous suture of silk or linen. Coprostasis of the jejunum is provided by narrow rubber bands thrust through the mesentery. The dotted lines indicate where the incision will be made into the esophagus and into the jejunum. Insert A shows the rubber catheter in position. Insert B shows the anastomosis of the esophagus and jejunum, the union of the stump of the duodenum to the jejunum, and the entero anastomosis.

Owing partly to the extensive manipulation and to the multiple openings in the bowel, and to the exposure of the esophageal lumen, infection is much more likely to occur following this procedure than in partial gastrectomy, where drainage is rarely if ever needed. Through a stab wound in the left loin a long medium sized soft rubber drainage tube with several additional perforations is carried up to the cavity left by removing the cardiac end of the stomach. This tube, fixed by suture to the skin, should not be in contact with the line of sutures, but about an inch from it. This operation is rather prolonged, but by using continuous intravenous injection of devulserol in King's solution and giving a transfusion of blood after the operation, shock can be combated.

Fig. 8 The Devine operation. The stomach has been divided between the two clamps, one of which has been thrust through the rent in the mesocolon. The distal stump of the stomach is closed, and the proximal end united to the jejunum after the manner of a Völz operation. It is then, if possible, drawn down through the rent in the mesocolon.

#### PALLIATIVE OPERATIONS

Not infrequently a large fungating tumor of the stomach, which is often a colloid cancer, will give a better prospect for cure than a small cancer which ulcerates and metastasizes quickly. Dr W J Mayo's apt remark that cancer coming to you is less malignant than cancer going from you, is real wisdom. However, these large cancerous masses may be found so adherent and extensive around the pylorus as to defy any reasonable effort at resection. When this is the case, a type of palliative operation such as that suggested by Devine of Australia for certain lesions in the pyloric end of the stomach, and a modification of which has been used by Pack of the Memorial Hospital in New York for pyloric cancer, may be adopted. This operation seems to have all of the advantages and none of the disadvantages of gastro enterostomy. Clamps on the stomach are placed, the clamp on the oral side being inserted through a rent in the mesocolon. The stomach is severed between clamps, preferably with the cautery, leaving ample margin for infolding the stomach, leaving ample margin for infolding the pyloric stump. The cardiac end is brought down

through the rent in the mesocolon and is sutured to the jejunum somewhat after the manner of a gastro-enterostomy (Fig 8) Or, as Pack does, both ends of the stomach may be closed and then a posterior gastro enterostomy made If this can not be done, the jejunum may be united to the stomach in front of the transverse colon and an entero-anastomosis made lower down In this way, the diseased mass at the pylorus is shunted off from the course of the food and given complete rest In the instances in which the mass proves to be not malignant, permanent recovery may be expected, but even when cancerous the growth of the neoplasm is to some extent retarded by the rest afforded the tissue, and a ready emptying of the stomach is secured

As has been mentioned, gastro enterostomy has little if any place in the surgical therapy of gastric cancer

In cancer of the cardiac portion of the stomach, where obstruction to swallowing is produced, a gastrostomy according to the method of Janeway, in which a strip from the anterior wall of the stomach with its base at the greater curvature is made into a tube for the gastrostomy, is a good procedure For a permanent gastrostomy this operation is superior to the oblique implantation of a tube according to the Witzel method, because it leaves a channel lined with mucosa which is not only more comfortable and more readily controlled, but which may be dilated and through which by means of a cystoscope radon implants can be inserted into the growth present in the stomach

#### CONCLUSION

We have, then, operations applicable to the cure or to the relief of cancer wherever it occurs in the stomach As the majority of cancers are in the pyloric portion and in the adjoining part of the body of the stomach, extirpation by the modification of the Billroth I described can often be done, or, if this is inapplicable, some form of the Billroth II may be used When the cardiac portion is involved or when the stomach is extensively diseased, a total gastrectomy may occasionally be done In inoperable conditions with obstruction, the operation of Devine when the cancer is in the pyloric end, or a gastrostomy according to the Janeway technique when the occlusion is at the cardiac end, may be used With an accurate diagnosis and a skillful execution of these operations, many lives can doubtless be saved that are now given up as hopeless Naturally, stomach surgery requires training and experience, and it will be found that with increasing experience cases that formerly were condemned as hopeless may sometimes be salvaged This, of course, may mean a mounting rate of operative mortality, but it will also mean an increased total number of cures and a larger number of cases that can be considered resectable

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## RADIUM THERAPY OF THE CERVIX UTERI

THE STANDARD TREATMENT IN USE IN THE CANCER CLINIC OF THE WOMAN'S HOSPITAL, NEW YORK, AND A COMBINED STATISTICAL REPORT OF FIVE AND TEN YEAR RESULTS SERIES 1919-1929<sup>1</sup>  
 GEORGE GRAY WARD M.D., F.A.C.S., AND NELSON B. SACKETT M.D., F.A.C.S., NEW YORK, NEW YORK

SINCE we commenced to treat cancer of the cervix with radium in 1919, we have published our 5 year results in 1925, 1928, 1930 and 1932. We have now completed 2 more 5 year series, or 10 series in 15 years, and are reporting our combined results.

As our experience increases we feel that a 10 year observation period gives us a more accurate evaluation of the curability of cancer by radiation therapy than the 5 year standard, therefore we are including in this report our 10 year results as well.

The standard technique we employ has been practically stabilized since 1920, the essential features are as follows: The preliminary building up of the patient's resistance when indicated in cachectic cases is accomplished by giving a blood transfusion if possible, as suggested by Farrar; spinal anesthesia is employed (half dose only is necessary) instead of a general anesthetic when there is no contra-indication. We believe anesthesia of some sort is necessary for accurate diagnosis and biopsy, and for the correct application of the radium in most cases. We give an initial dosage of 3,000 to 4,200 milligram hours of radium, depending on the extent and size of the cancerous growth. One hundred milligrams are placed intracervically with the equivalent of 1 millimeter of platinum screening, and in the periphery at the junction of the cervix with the vaginal fornices platinum needles (0.5 millimeter) containing 12½ to 13 milligrams each are inserted, or if the vaginal vault is invaded, 75 milligrams of radium in silver boxes are used in a spring colpostat similar in principle to that of Kegaud.

In exceptional cases of extensive disease we have used from 6,000 to 6,700 milligram hours for the initial dose. Since 1930 high voltage X-ray therapy has been employed by Dr McIntosh, who is in charge of our X-ray Department, according to the following technique in Class III and IV cases. Two series 6 to 8 weeks apart, 4 portals, 800 r per portal, at 200 kilovolts, 30 milliamperes, 50 centimeter distance, 0.5 centimeter copper and 1 centimeter aluminum filter. The size of portals varies with the patient and the extent of disease. Occasionally a third series has been given.

Since June, 1933, we have been using the fractional treatment whenever it has been feasible to the patient. The same factors of milliamperage, filter and voltage are used, the distance is increased to 70 centimeters and a fractional distribution of dosage is given as follows. Two portals are treated daily on the same side anteriorly and posteriorly, each side of pelvis, therefore, receiving treatment every other day. Two hundred r is given to one anterior and one posterior portal daily until all portals have received 2,000 to 2,400 r each. Occasionally 250 r per portal is given. The exact amount and speed of administration are judged in each individual case. This treatment takes from 3 to 3½ weeks and is not ordinarily repeated. We are in accord with Dr McIntosh's belief that this fractional method gives greater promise of success, and is preferable whenever possible in spite of its economic disadvantages. In cases with extensive disease we have lately been following the practice of Healy and others of preceding the radium application with the X-ray therapy.

Potassium permanganate douches and an elevated posture to promote drainage and separation of any slough are begun at once. In cases where there is an exuberant cauliflower mass protruding into the vagina, we remove it with the high frequency knife before applying the radium. Biopsies are all done with the same instrument. We stress the importance of distance screening by distending the vagina with gauze to its capacity to keep the bladder and rectum as far away as possible from the radium rays, and we use a self retaining catheter to keep the bladder collapsed during the radium application. We believe that anchoring the radium tube in the uterus is an important detail.

The outstanding feature of our method, however, is the frequent follow up inspection made by the surgeon himself throughout the 5 year period if at all possible. During the first 3 years a monthly inspection is made, and after that the patient is seen every 2 or 3 months. If the follow-up examination discloses evidence of a beginning recurrence in the vaginal walls or fornices, a further irradiation is given in time to check the recurrence.

Presented at the Symposium on the Treatment of Cancer before the Clinical Congress of the American College of Surgeons October 17, 1934.

TABLE I—FIVE YEAR END-RESULTS IN CARCINOMA OF CERVIX PATIENTS SEEN FROM FEBRUARY 15 1919 TO MAY 15 1929

	Living	Five year survival rate per cent
Total seen	457	24.10 (absolute)
Total treated	439	25.28 (relative)
Untreated	18	
Untraced	23 (2.9%)	
Completed follow up	97.04%	

Untraced as dead from cancer

ence in its incipency. Our employment of repeated irradiations after the initial treatment is for metastatic outbreaks or residua in the vagina and consists of a relatively small dosage usually in the form of platinum needles, although should the nature of the recurrence require it we use tubes or flat containers. The average dose ranges from 300 to 1200 milligram hours depending on the size and location of the recurrence. We attribute our success in saving some cases to the early discovery of a metastasis, occurring 2, 3 and 4 years or longer after the initial treatment. The value of a personal follow up each month we believe cannot be overestimated. In no other way can we detect early recurrences long before the patient has subjective symptoms.

We have been criticized for this practice of repeated irradiation but we believe criticism is due to a misunderstanding as to our method. We are not employing repeated applications of a heavy dosage at the initial site of the disease. We appreciate that over radiation of radioreistant tissues may result in necrosis and fistulae and late radium reactions. We are of course in agreement with the belief that the surviving cancer cells become more radioreistant after the initial irradiation and that therefore the initial dose should be the maximum consistent with safety. Our initial dosage approximates that used in the leading clinics.

TABLE III—TEN YEAR END RESULTS IN CARCINOMA OF CERVIX PATIENTS SEEN FROM FEB 15 1919—MAY 15, 1924

	5 year survival as of May 15 1929			10 year survival as of May 15, 1934		
	Living	Survival rate per cent	Untraced	Living	Survival rate per cent	Untraced
Total seen	208	25.46 absolute	8	37	17.9 absolute	11
Total treated	202	26.3 relative	3.9%	37	18.31 relative	45%
Untreated	6					

Includes one case on information since proved unreliable

TABLE II—FIVE YEAR END-RESULTS IN CARCINOMA OF CERVIX PATIENTS SEEN IN TWO YEARS FROM MAY 15, 1927 TO MAY 15 1929

Year	Total seen	Treated	Untreated	Five year survival Cases Per cent	Untraced
1928	47	43	4	23—27.66 (absolute)	1
1928-9	53	53	0	23—24.53 (absolute)	1
Total	100	96	4	26—26 (absolute rate)	2 (2%)

Relative five year survival 27.1%

Comparison of results by classes with other clinics must of necessity be only approximate, due to the personal equation in estimating the extent of the disease. Heyman gave a well known example of this when three experienced gynecologists, visiting him in Stockholm, all classed a case differently as to the extent of the cancer. (The author Ward, was one of the three.) How often has it happened that an apparently early case with mobile uterus has been found at operation to have an invasion of the parametrium and glands?

It is our opinion that the simplest form of classification of the extent of the disease is the most useful for comparisons. Therefore, we prefer Schmitz's, which we understand is used in this country by the majority of clinics.<sup>1</sup> The League of Nations classification is too complex to be practical in our belief, and comparisons with other clinics are more open to error. However, we use both systems for statistical purposes.

We believe that if cases were classified simply as early or late depending upon whether the disease has spread beyond the cervix there would be less confusion and more accurate comparisons.

It is not correct, we think, to group League of Nations Class I and II cases together as early cases as Crossen has done, since the League of Nations Class II includes a large number of Schmitz Class III cases which are not early but already have the disease extending into the parametria and vagina, but are nevertheless League

<sup>1</sup>An inquiry made by us in October 1934, of 13 of the leading clinics in the United States showed that 10 are using the Schmitz classification, 3 of these also use the League of Nations. Only 1 is using the League of Nations classification alone. Two use a personal classification.

TABLE IV—OPERABILITY IN CARCINOMA OF  
CERVIX

Number of total	Per cent
457	100.0
94	20.6
5	1.1
363	79.4
317	69.4
40	8.7

TABLE VII—PRIMARY MORTALITY OF RADIUM  
TREATMENT FOR CARCINOMA OF CERVIX

Cases treated with radium	Rad um	Deaths	Deaths per 100 appl cations	Total all classes to date	Class I Schmitz [Stage I]	Class II Schmitz [Stage I & V]	Class III Schmitz [Stages II & III]	Class IV Schmitz [Stage IV]	Class V Schmitz [Stage V]	3	3	Deaths	Cases
676	998	10	1 00	1 6	16	116	462	9	43	4	9 3	13 8	0
				0 86	0	0 54	0 68	1 1					0

rather than not give the patient a chance, and our results in many cases seem to justify this practice

Completed to May 15, 1934

Table I shows the 5 year survival rate of all cases seen from 1919 to 1929 inclusive. Table II shows the 5 year end results in the last two series 1927-29.

Table III gives the 10 year end-results from 1919 to 1924. This table shows that more than two-thirds of the patients surviving 5 years have

The untreated cases here, in our judgment, too far advanced for treatment (Table V). Table VII shows that many Class IV cases probably should not have been treated.

We would ask our critics, what would they do under such circumstances? He, man, in an address before the Royal Society of Medicine in 1929, stated, "We have in recent years in cases of persistent small residua and in cases of small residual recurrent disease made use of intrablation of radium needles." We do likewise.

She was followed with two rays therapy. The result was a complete disappearance of the disease, with perfect healing symptoms but at the monthly inspection a size of a large pea, which had been found just inside the mitralis on the right ventricle wall. This was promptly irradiated with two rays treatment.

the vaginal tract, the following case seen recently is an example of our procedure

As accurate classification of the extent of the disease must of necessity be difficult and will always be variable as the judgment of different observers varies, therefore comparisons where complicated systems are employed are of doubtful accuracy. We have seen with Stoeckel, Mizulicz, Heyman and many others that only the absolute universal rate of an entire series is dependent upon the purposes of comparison.

of Nations Class II because "the uterus still maintains some degree of mobility." The League of Nations Class II corresponds to an early Schmitz Class III, in our opinion. Our cases with the disease limited to the cervix according to Schmitz's classification show Class I 2 per cent, Class II 18.0 per cent, or 20.6 per cent for our "early" group—not 60 per cent as has been

Total cases seen	451	100 0
Cases treated with radium	416	96 1
Unirradiated with radium	18	3 9
Radium operability 96 1 per cent		

TABLE VIII.—CARCINOMA OF CERVIX FOLLOWING SUPRAVAGINAL HYSTERECTOMY

	Number	Per cent
Total cases seen	457	
Hysterectomy stump	27	5.90
Living 5 years	11	
Absolute survival		40.4

TABLE IX.—FIVE YEAR END-RESULTS ACCORDING TO EXTENT OF DISEASE SCHMITZ CLASSIFICATION OF CARCINOMA OF CERVIX CASES

Class	Total seen	Treated	Un-treated	Living 5 years	Absolute survival per cent	Relative survival per cent	Early rate
I	9	9	0	6	66.6	66.6	5.17%
II	85	85	0	43	50.6	5.0	
III	11	11	0	6	19.6	19.6	1.74%
IV	40	4	36	0	0	0	
Total	45	4.0	18	117	24.70	5.5	

It is to be noted that this table shows that early cases Class I and II had an absolute and relative survival rate of 5.17 per cent and the late cases Class III and IV had an absolute survival rate of 17 per cent and a relative rate of 1.74 per cent.

Table XII excludes 107 cases with previous or subsequent treatment or operation elsewhere, or treated previous to May 1905 when method was unstandardized.

Our results have been obtained during a period in which our X-ray therapy was inadequate, judged according to modern practice. Our series from 1905 therefore should show an improved survival rate.

## SUMMARY

During 15 years at the Woman's Hospital we have had under our observation for 5 years or longer 457 cases of carcinoma of the cervix, 430 of whom have been treated with radium.

These 15 year series have a relative (treated) survival rate, 5 years or longer, of 25.3 per cent and an absolute survival rate (all cases seen) of 4.29 per cent with a completed follow-up of 97.04 per cent, all untraced cases are classed as dead of cancer. Early cases showed 5.17 per cent survival.

Two hundred and eight cases have been observed for 10 years or longer and have a relative survival rate of 18.31 per cent and an absolute rate of 17.79 per cent. This shows that more than two-thirds of the cases that survived 5 years lived 10 years or longer, in spite of the normal death expectancy in the various age groups.

TABLE X.—FIVE YEAR END-RESULTS ACCORDING TO EXTENT OF DISEASE LEAGUE OF NATIONS CLASSIFICATION OF CARCINOMA OF CERVIX CASES

Stage	Total seen	Treated	Un-treated	Living 5 years	Absolute survival per cent	Relative survival per cent
I	64	64	0	42	58.1	51.1
II	130	129	0	46	28.7	2.7
III	18	18	0	16	22.6	11.5
IV	40	5	35	0	0	0
Total	457	4.2	18	117	24.70	15.8

TABLE XI.—FIVE YEAR END-RESULTS ACCORDING TO EXTENT OF DISEASE COMPARISON BETWEEN SCHMITZ AND LEAGUE OF NATIONS CLASSIFICATIONS

Classification	League of Nations	Total seen	Treated	Un-treated	Living 5 years	Absolute survival per cent	Relative survival per cent
I & II	I	64	64	0	42	58.1	51.1
III	II & III	130	129	0	46	28.7	2.7
IV	IV	40	5	35	0	0	0

TABLE XII.—FIVE YEAR END-RESULTS IN CARCINOMA OF CERVIX TREATED BY UNIFORM WOMAN'S HOSPITAL RADIUM TECHNIQUE (COMPARE WITH TABLE I)

	Total	Treated	Un-treated	Living 5 years	Absolute survival per cent	Relative survival per cent
Total	35	3.5	65	46.5	25.44	25.44
Classes I & II (all cases)	12	62	4	46.5	25.44	25.44
Classes III & IV (all cases)	55	2.6	33	18.5	16.56	16.56

\*The figures in parentheses are of "late" cases.

A frequent personal follow-up of all cases throughout the 5 year period of observation is essential if we are to discover early metastatic recurrences or residuals in the vaginal tract before objective symptoms develop, and in time to arrest the recurrence.

Re-radiations of this character are of course curative or palliative value in many cases.

The classification of the extent of the disease should be simplified to the utmost degree to make comparisons with other clinics of value.

The classification of Schmitz is less complicated than that of the League of Nations, and we believe is in more general use in this country.

UNILATERAL CARCINOMA OF THE BREAST TREATED BY SURGICAL  
OPERATION AND RADIATION<sup>1</sup>

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## REFERENCES

- for treatment, in our opinion, is the only criterion of value in comparing methods of therapy. The frequent personal follow-up inspection made by the surgeon himself throughout the 5 year period of observation will not only result in fewer untreated cases and therefore improve his absolute survival rate, but it will also enable him to save more patients.

The absolute-cure-rate of all cases applying for treatment, in our opinion, is the only criterion of value in comparing methods of therapy. The frequent personal follow-up inspection made by the surgeon himself throughout the 5 year period of observation will not only result in fewer untreated cases and therefore improve his absolute survival rate, but it will also enable him to save more patients.

the least restoration of motion of the arm. If the tumor is in the axilla, the axilla is usually best removed or, if the tumor is in the upper or lower quadrant of the breast, a vertical incision will give the best results in the way of complete removal of the growth and adequate exposure for dissection. If the growth is in the extreme upper or outer quadrant of the breast, a transverse incision is usually best.

[illegible]

**RADICAL AMPUTATION**

The technique of the primary radical amputation has been fairly well standardized. I do not make a uniform type of incision in the skin, for I believe that the best results are obtained when the incision is planned in each case so as to remove the greatest amount of skin around the region of the thoracic wall. The branches of the axillary vessels, to the entrance of the axillary vein into the thoracic wall. The dissection of the axillary and sternal lymph nodes is completed, and all of the nodes are removed. The correct process of the scapula is severed. The attachment of the musculature is severed. The attachment of the musculature is severed. The attachment of the musculature is severed.

Presented at the Symposium on the Treatment of Cancer, before the Clinical Congress of American College of Surgeons, Boston, October 17, 1934

sels are caught and ligated as the dissection of the lymph nodes proceeds toward the sternum, the long thoracic and subscapular nerves are preserved. This completely outlines the tissues to be removed, which are still attached to the wall of the thorax, they include the breast, subcutaneous tissue, axillary nodes and node bearing fascia, the pectoralis minor muscle, and the greater portion of the pectoralis major muscle. These structures are then dissected from the wall of the thorax, starting from the lateral aspect, the perforating intercostal vessels are ligated as the dissection proceeds. The anterior sheath of the rectus muscle is removed as the dissection proceeds toward the median line, and the entire carcinomatous portion is removed in one mass.

From the standpoint of operative procedure, the best results from surgical treatment of carcinoma of the breast are obtained from primary radical amputation. There are many variations in methods of carrying out the minor details of the radical amputation but the fundamental principles of the operation are invariable and should be carried out in all cases accepted for surgical treatment. This initial treatment is by far the most important procedure and the possibility of a cure depends on the thoroughness with which it is carried out. The importance of this cannot be overestimated, for secondary operative procedures are rarely curative. I believe that one of the important factors in the unsatisfactory results obtained from surgical treatment is the relative frequency with which minor operative procedures are carried out for malignant disease. The most unsatisfactory results from surgical treatment are obtained from secondary radical amputations following a previous minor operative procedure. Approximately 7 per cent of our radical amputations at the Mayo Clinic have been secondary procedures of this type. In this group, lymphatic involvement had occurred in 79 per cent of cases, as compared with 64 per cent in which primary radical amputation had been done. The results of the secondary radical amputation are correspondingly less satisfactory. These figures, however, do not give the true results in those cases in which a primary, minor operative procedure had been done because in approximately 60 per cent of these, the condition was hopelessly inoperable at the time the patients presented themselves for examination. This is particularly true of cases in which some type of escharotic had been used among these cases more than 80 per cent were inoperable at the time of our examination.

## TWO TYPES OF CASES

From the surgical standpoint, lesions of the breast may be grouped in two classes, first, the group in which a clinical diagnosis of malignancy can be definitely established and a primary radical amputation can be done immediately, and second, the group in which the diagnosis cannot be definitely established on the basis of clinical manifestations of the disease.

In those cases in which a definite clinical diagnosis can be made, the disease is usually fairly well advanced, and immediate, primary, radical amputation is indicated. Inasmuch as one of the most important factors in the results of operation is the extent of the disease at the time of operation, the results will depend on the extent of the lesions of patients who are accepted for operation. Statistical studies on the results of operation are often misleading and do not give the true conception of the results obtained, unless it is known where the line is drawn between operable and inoperable growths. If only small lesions without demonstrable axillary metastasis should be considered acceptable for surgical treatment, the statistical results would be very satisfactory. This, however, would include only a relatively small number of patients, for the majority of patients present fairly well advanced lesions at the time of their initial examination. In most cases, the lesions are more extensive. Many patients present ulcerated lesions of the breast and metastasis to axillary lymph nodes. Radical surgical treatment cannot be expected to effect cure in these cases but in many instances can give comfort and additional life, and I believe the patients deserve the benefit of surgical treatment.

There are varied opinions as to what constitutes an operable condition. I shall state briefly the criteria of operability followed in this series. Any lesion of the breast was considered operable if it was freely movable from the thoracic wall, regardless of ulceration, and in some cases even if there were cutaneous nodules proximal to the tumor. The condition was considered operable regardless of the presence or absence of palpable axillary lymph nodes and in some cases in which supraclavicular nodes were palpable and were confined to one side of the neck, the condition was considered operable. Patients were also accepted for operation if they presented the diffuse type of malignant disease, so called inflammatory malignancy, or if the breasts were in a state of lactation, or, in most cases, if patients were pregnant. The condition was considered inoperable if there was a large growth fixed to the thoracic wall and if there was extensive metastasis to the regional

## HARRINGTON UNILATERAL CARCINOMA OF THE BREAST

TABLE II—FIVE YEAR RESULTS COMPARISON WITH OTHER STATES IN WHICH OPERATION WAS

Surgery alone without axillary metastasis	Total	Patients operated on		Per cent of Patients traced
		Lived 5 or more years	Traced	
69 g	531	494	345	69 g
Surgery and radiation with out axillary metastasis	649	592	431	72 g
Surgery alone with axillary metastasis	649	604	147	24 g
Surgery and radiation with axillary metastasis	1552	1447	416	28 g
Total	3381	3137	1339	42 g

not believe that surgical treatment should be refused in these cases

[illegible]

TABLE I—FIVE YEAR RESULTS COMPARISON  
OF CASES IN WHICH AXILIARY INVOLVE-  
MENT WAS PRESENT WITH CASES IN WHICH  
IT WAS NOT PRESENT

	Patients operated on	Lived 5 or more years after operation	Per cent of Patients traced
Without axillary metastasis	Total	Traced	Patients
With axillary nodal metastasis	180	1086	776
Total	2201	2091	563
	9381	3137	1330
			427

[illegible]

TABLE III—FIVE YEAR RESULTS RELATIONSHIP BETWEEN INVOLVEMENT OF AXILLARY NODES AND GRADE OF MALIGNANCY

Treatment	Grade of malignancy	With involvement of axillary nodes				Without involvement of axillary nodes			
		Patients operated on		Lived 5 or more years after operation		Patients operated on		Lived 5 or more years after operation	
		Total	Traced	Patients	Per cent of traced	Total	Traced	Patients	Per cent of traced
Surgery only	1	4	4	4	100.0	29	29	27	93.1
	2	40	38	22	57.9	67	64	46	71.9
	3	174	165	45	27.3	82	72	45	62.5
	4	326	316	54	17.1	56	54	47	87.5
Surgery and roentgen rays	1	8	8	8	100.0	28	26	26	100.0
	2	122	107	49	45.8	60	51	44	86.3
	3	456	424	115	27.8	84	81	49	60.5
	4	78	73	160	21.9	53	50	32	64.0

## RESULTS

In the accompanying tabulations all patients operated on have been included in the surgical results, regardless of the extent of the disease at the time of operation, and a high percentage of cases is included in which all that could be hoped for was palliation. The tabulations also include those cases in which a primary operative procedure had been carried out elsewhere, followed by a radical procedure at the clinic as well as those cases in which the prognosis was influenced by other associated conditions such as diabetes, exophthalmic goiter, pregnancy, lactation, and diffuse cancer *en cuirass*. It is not within the scope of this paper to discuss the results obtained, classified according to the various groups. I shall publish these in a subsequent paper.

In this paper I shall give the 5 year results obtained from radical amputation for unilateral carcinoma of the breast. I shall then compare the 5 year results obtained in those cases in which radical amputation constituted the complete treatment, with the 5 year results in cases in which roentgen therapy was administered, in addition to performance of radical amputation. I shall also compare, according to the 4 grades of malignancy, the 5 year results obtained by surgical treatment only, with those obtained by surgical treatment and roentgen therapy together. These results are based on all cases in which operation was performed at the clinic from January 1, 1910 to January 1, 1929, this permits the compiling of 5 year results in all cases. The cases numbered 3,181 and the results are based on 3,137 cases in which the patients were traced, or 92.64 per cent of the entire series.

In Table I are compiled the 5 year results of treatment by radical amputation. The entire series has been divided into two groups for comparison depending on the presence or absence of involvement of axillary lymph nodes at the time of operation. In Table I it is shown that the results were much better in the cases in which axillary metastasis to lymph nodes had not taken place before the time of operation. Therefore, the presence or absence of metastasis to axillary lymph nodes at the time of operation is one of the most important indications in estimating prognosis. I believe that in all studies on the results of treatment of carcinoma of the breast, division into these two main groups should be made as an initial attempt to obtain uniformity of types of cases for comparison of results.

In Table II are recorded the 5 year results obtained in cases in which radical amputation only was done, for comparison with the 5 year results obtained in cases in which radical amputation was followed or was preceded by roentgen therapy. This study shows that (as compared with similar patients who were subjected to radical amputation only) 3 per cent more patients without axillary nodal metastasis lived 5 years, who received roentgen therapy in addition to radical surgical treatment. Among cases in which axillary nodal metastasis was present, a similar comparison disclosed that 4 per cent more patients lived 5 years, who received roentgen therapy in addition to radical surgical treatment. Whether treatment was by surgery only or by surgery and roentgen rays, the difference in the percentage of comparable patients who lived 5 years was small. By "percentages of comparable patients" I mean





those whose axillary nodes were not involved, the larger number found to be living at the end of 5 years had been treated by surgery and roentgen rays

In comparing the results in cases in which treatment was by surgery alone, with those in which treatment was by surgery and radiation, although the study discloses no significant difference in the results obtained, as has been said, and substantiates the former study, it indicates that there may be some improvement in the results obtained in high grades of malignancy particularly if axillary nodal metastasis is associated. When treatment is by surgery and radiation, and the grade of malignancy is low, radiation as an adjunct to surgical treatment seems to be of no value

This study shows that the grade of malignancy gives the most important indication as to the prognosis, for patients whose growths were of grade 1 lived the longest period of time, and patients whose growths were of grade 4 lived the shortest length of time. This holds true whether or not axillary nodal metastasis was present or absent

In Table IV is recorded a study of the patients who died of malignant disease of the breast following operation or following operation and radiation in this group of cases the complete end results are definitely known. This study was made to determine the length of life of those patients who were treated surgically only as compared with those who were treated by surgery and roentgen rays

This study shows that patients treated by radical surgical operation only and who presented no axillary nodal metastasis at the time of operation, lived on an average of one year longer than a similar group of patients who were treated by surgery and radiation. Patients treated by radical surgical operation only and who presented axillary glandular metastasis lived approximately

6 months longer than the group of patients treated by radical surgical operation and radiation. These figures are significant and indicate that roentgen therapy is of no definite aid in radical surgical treatment of carcinoma of the breast and they also indicate that it may be detrimental to the results of surgical treatment in some cases. These figures, however, are not conclusive, because a smaller percentage of patients who underwent both surgical operation and roentgen therapy were dead at the time of the compilation of these results, and as the end results are obtained on a higher percentage of these cases than this, the tendency will be to lessen the difference in length of life of patients of the two groups

#### COMMENT AND CONCLUSIONS

The most efficient surgical treatment for carcinoma of the breast is primary radical amputation. The results depend on the thoroughness with which this procedure is carried out in an initial operation

This study reveals that roentgen therapy has been of no significant aid as an adjunct to radical surgical treatment and should be used not as a routine treatment, but only if the malignancy is of high grade, for the 5 year results indicate that it may be of aid in cases in which malignancy is of high grade

The end results in cases in which the patients have died show that the patients who were subjected to surgery only lived longer than those who were subjected to both surgery and roentgen therapy. In these cases it is evident that roentgen therapy was not of aid to surgical treatment and may have been detrimental to it in some cases

The most important factors in prognosis are the extent of the disease, as shown by the presence or absence of axillary nodal metastasis, and the degree of malignancy, as shown by microscopic examination of the lesion





Fig 1 First case at Barnard Free Skin and Cancer Hospital of carcinoma of lower lip treated by radiation from radium February 1918 neck dissection 3 months after treatment of lip Patient still living free of evidence of carcinoma.



Fig 2 A Satisfactory result can confidently be expected from proper use of radium Neck dissection indicated regardless of histology of tumor B Lip healed Suprahyoid dissection complete Patient well, 3 years later

tissue in which the cancer may lie as well as the actively involved cancer tissue. This necessarily results in loss of much normal tissue. Radiation can be administered without hospitalization and without loss of the patient's time from business or social activities. Surgical removal on the other hand, although not necessarily disabling to the patient, will usually require some loss of time, and sometimes hospitalization. Discomfort to the patient from radiation is most variable. Rarely will a patient go through the subsequent reaction without some inconvenience or pain. In surgery pain and discomfort are not great; they occur almost immediately and last a comparatively short time as compared to the long drawn-out healing from radiation. Hence in the average case it will be seen that there is not a great deal of choice. For my own part, it is my practice to excise with the scalpel lesions up to one centimeter in diameter by means of V excision. Lesions larger than this are treated by radiation with radium. This general rule does not apply to lesions of the

mucous membrane, particularly at or near either angle of the mouth. I regard these lesions as distinctly of more serious import than lesions of the vermillion border or of the mucocutaneous junction. Such lesions are treated with wide surgical excision and immediate repair of the resultant defect by utilization of tissue from the upper lip.

It is difficult to lay down hard and fast rules for radium therapy because, in different clinics, the quantity of radium available, type of applicators and type of ray employed are subject to such wide variation. But some rules should be standard. First, the area to be irradiated should comprise a great deal more than the visible or palpable margins of the growth. Second, the estimated 'dose' should be given in one sitting or within a limited time, third, if the estimated dose (and dosage should be overemphasized rather than underestimated) has failed to cause complete retrogression, radiation should not be persisted in. It is well to remember that tissue irradiated to the point of destruction of cancer is not favorable tissue for



Fig 3 Almost identical case to Figure 2. Trophoblastic neck dissection repeatedly attempted and refused until large "boil like" metastasis appeared in submental region. Neck dissection too late. Patient died 2 years after first consultation.

kindly wound healing should surgical excision of recurrence or plastic repair of defects become advisable. On the other hand, should surgical excision of the primary lesion be the method of choice for the first attempt at eradication and should recurrences appear, radiation may be employed without regard to the operative wound, always with the reservation, however, that any scar tissue is apt to react unfavorably to radiation. Also, let me sound a warning—no one has the right to undertake the treatment of cancer of the lower lip with the idea in mind that if one method of treatment fails another may be tried. He who first treats the condition has the golden opportunity. If he fails to obtain a cure, the theory that through radiation the lymphatic channels are blocked so that the cancer cell cannot

the patient's chances are reduced at least so per cent irrespective of the subsequent method of treatment.

Discussion of the topic of treatment for the second phase of the disease, namely, treatment of the regions of lymphatic involvement by metastases, develops a veritable battleground of divergent opinions. The theory of radiation in the treatment of cancer in the lymphatic system is based upon the power of either roentgen- or radium rays to penetrate the skin and to impinge themselves upon the cancer cell with enough destructive energy to kill it. There is another theory that through radiation the lymphatic channels are blocked so that the cancer cell cannot



Fig 4

Fig 4 Primary lesion left side lower lip successfully healed by radium. Large metastasis in submaxillary region, fixed to perosteum of mandible, but still operable. Patient advised and accepted complete left neck dissection. Fig 5 Very obvious case of existence of crossed metastasis. Indicates necessity for bilateral suprahyoid resection.



Fig 5

Fig 6 Lip "blown out" in V fashion by radiation. Recurrence in submaxillary region of normal tissue pair very difficult due to deratization of normal tissue. Note metastasis in submaxillary region which did not respond to interstitial radiation. (Am J Surg, 1934, 24, No 3)



Fig 6



Fig 7 Example of possibilities of successful surgery in advanced case. Repair satisfactory from cosmetic and functional viewpoints

wander through these channels. Still a third theory is that radiation is effective through its power to cause a marked thickening of the capsule of a lymph node in which cancer may lie, to such an extent that even though the cancer cell may live it cannot grow through this capsule. The great drawback to the practical application of these theories is the undisputed fact that radiation does not have the same effect upon all cancer cells and neither does all normal tissue react similarly to radiation. The most telling observation to be made in regard to the practice of radiation therapy in the treatment of possible metastases from cancer is that the so called prophylactic radiation therapy is given with a great deal less intensity than when radiation is employed as a possible curative agent when metastases are definitely present. The logic of this common practice is to me obviously fallacious.

There was a time in the first twenty years of radiation therapy when the radiologist received for treatment only such cases as were not accept-

able to the surgeon. Now the pendulum has swung in the other direction and the surgeon is seeing more and more the patient who has passed through the hands of the radiologist and comes to him in the hope that something can still be done after radiation has failed.

The surgical removal of the subcutaneous lymph bearing tissue which immediately drains the lower lip is an anatomical feat which involves the absolute removal from the body of a certain amount of tissue in all cases. The lymph channels from the lower lip are unusually constant and the lymph nodes into which they drain are located above the hyoid bone and extend from the lower one third of one parotid gland to the other. Primary metastases to more distant nodes are exceedingly rare as are, also, metastases to the lungs, mediastinum, or more distant parts of the body. Contrary to some writers on this subject, I have found crossed metastases of frequent enough occurrence to justify bilateral removal of tissue in all cases regardless of the location of the




Fig 8 Example of possibilities of interstitial radiation. Patient's general condition did not warrant radical surgery. Patient barely survived pain and toxemia accompanying slow destruction by use of radium. Plastic repair was very difficult due to devitalized normal tissue which bor-

dered upon the defect. Final result was a water tight mouth but a poor cosmetic appearance. Patient died 3 years after treatment. Autopsy disclosed bronchiectasis but no evidence of carcinoma. (1st J. Cancer 1937: 15 No. 3)

The operation is performed in the same manner whether or not lymph nodes are palpable. The only qualification of this statement is that should metastases be proved in certain groups of lymph nodes it is recognized that the disease has probably gone beyond the area of initial operation and an extended surgical interference is indicated. This procedure is entirely logical as it concerns itself purely with the pathology of the disease. Its disadvantages are manifold, inasmuch as it subjects the patient to a major surgical procedure which in a certain portion of cases will be unnecessary, since all cases of cancer of the lower lip do not form metastases.

Fig. 9 Result following Stewart operation for small lesion on mucous membrane surface



Naturally, such an operation should not be advocated for a patient who is a poor surgical risk with an estimated life expectancy of 3 years or less. But the number of patients who present themselves, 3 to 5 years or longer after the lip has been healed, with advanced metastases to the cervical nodes has caused me to believe that to heal the lip lesion without removal of the immediately draining lymphatic area is just as great a mistake as, for instance, to remove the breast for cancer and let the axillary lymph nodes remain behind.

Undoubtedly, the ideal surgical treatment of cancer anywhere in the body is a one stage operation which removes the primary lesion and the regional lymphatic system at one time. This ideal can be attained in cancer of the lower lip. Stewart in 1909 advocated and described such an operation. It is to be recommended for the treatment of cancer recurrent after any form of treatment and in cancer of the mucous membrane surface of the lip. But since radiation in any stage of the disease and V excision for the small lesion has proved of such value in the treatment of the primary lesion, treatment has logically fallen into the two stages already described.



Fig. 10 Result following Stewart operation for extensive lesion lower lip Entire lower lip reconstructed

Obviously it cannot be considered logical to subject a patient to the surgical attack on the lymph channels unless it is reasonably certain that his primary lesion is healed. For a number of years I have adopted the following rather arbitrary practice in regard to time of removal of lymph nodes after radiation of the primary lesion. If there are no lymph nodes palpable at the time of treatment of the primary lesion, wait 3 months (local recurrences following radiation will usually recur within 3 months).



Fig. 11 Result following swing of tissue from upper lip to replace excised tissue of lower lip for lesion near the angle of the mouth (*Am J Cancer* 1931, 15 No 3)

ally show themselves within this time) When nodes are palpable, but movable, and not over 15 millimeters in largest diameter wait 6 weeks. If the nodes are fixed or hard, and most probably carcinoma, the operation for their removal is undertaken as a definite part of the initial treatment of the primary lesion, preferably at the same sitting. Occasionally, the general condition of the patient will necessitate a division of treatment into two or more stages. These are usually desperate cases in which cure is hardly to be hoped for and as stated previously, if metastases are present in any of the nodes above the hyoid

bone subsequent operation for removal of the deeper lymph channels and lymph nodes must be performed on one or both sides, this operation extends from the clavicle to the mastoid process and its degree of success is to be measured by the thoroughness of its performance.

In the case of V excision, unless it is necessary to wait for confirmation of the diagnosis of cancer by microscopic examination of the excised tissue, the suprahyoid neck dissection is per-

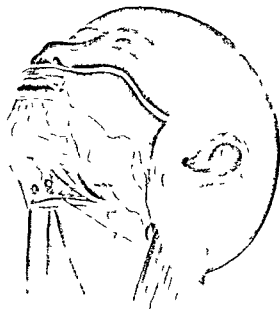


Fig. 12A Superficial lymphatic vessels and nodes which drain the lips (after Ponier and Cuneo). Note the interlacing immediately beneath the vermilion border and the long distance the vessels course in the superficial fascia before they dip toward the deep structures

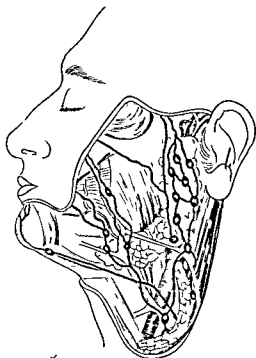


Fig. 12B Deep lymphatic system of the upper neck. The following locations of nodes are important: lower parotid regions, submaxillary regions, submental regions, and the region along the facial vessels above the lower border of the mandible (*Am J Cancer* 1931, 15 No 3) (After Toldt)



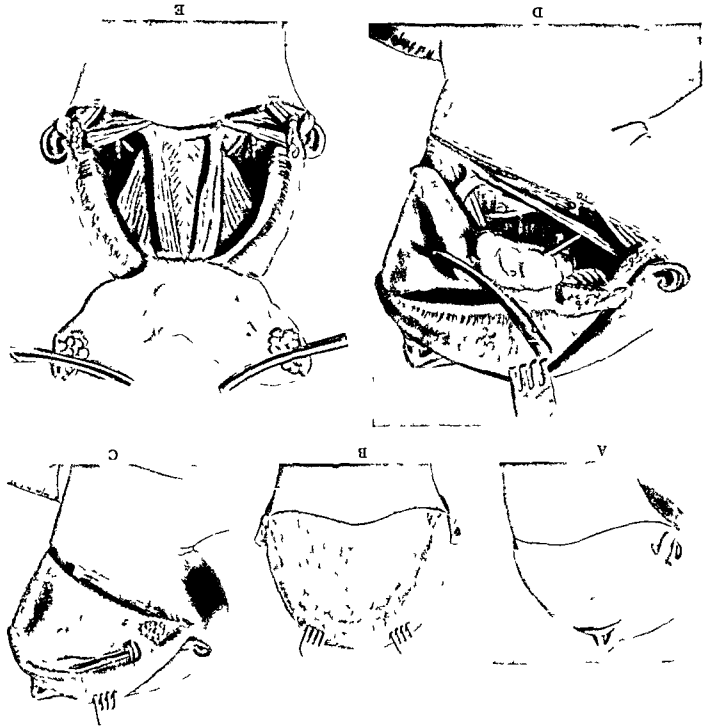


Fig. 13. A, First step. Skin incision carried only through the thickness of the skin. B, Second step. Deepening of the line of incision through the platysma myoides muscle and superficial fascia to the deep fascia. C, Third step. Showing the common facial vein ligated as it pierces the deep fascia, and the ligation of the facial artery and vein above the border of the mandible. D, Fourth step. The lower third of the parotid gland, all tissue above to the

formed at the same sitting. Should delay be occasioned by the lapse of time for the aforementioned confirmation of the diagnosis, the operation for removal of the lymph nodes is undertaken as soon as possible after the lip wound has healed. Radiation, either from the radium bomb or from the X-ray tube of proper voltage, has its strong advocates both as a prophylactic and curative agent in the treatment of metastases. There is little carefully checked clinical evidence advanced

depth of penoscum of the mandible and the deep fascia below, have been raised, the facial artery is freed for ligation as it enters the capsule of the submaxillary salivary gland. a, Common facial vein. b, Parotid salivary gland (cut). c, Submaxillary salivary gland. d, Facial artery. e, Hypoglossal nerve. E, Fifth step. Dissection completed on both sides. The amount of tissue removed is plainly indicated (*Am. J. Cancer*, 1931, 15 No. 3).

to support this method. The fractional treatment by X ray (or radium) as advocated by Coutard has lately gained many sponsors. This method impresses me as more dangerous than surgery and requires much further trial before it can be generally accepted. Interstitial radiation, on the other hand, has something to recommend it. When accurately employed, tumor tissue itself will absorb the brunt of the intensive radiation. Its success will depend upon the radiosensitivity of the tumor, the correct estimate of dosage and the accuracy of its application. The last can best be attained through operative exposure of the field to be irradiated. While I have yet to see a case of proved metastases cured by this method, I have observed such marked palliation without severe reaction to the patient that its use is to be recommended for inoperable cases.

I have not found the grading of either the primary tumor or of metastases to be of great value. We know that the more highly differentiated the tumor cells are, the less malignant and the less radiosensitive the tumor is apt to be. The converse is also true. Yet there are so many exceptions to this rule that it is not fair to the individual patient to base choice of therapy and prognosis

entirely upon the microscopic appearance of the tumor.

#### SUMMARY

The treatment of cancer of the lower lip must be divided into two phases: the treatment of the primary lesion and the treatment of the adjoining lymphatic system.

In view of our present knowledge, the treatment of the primary lesion can be standardized. The important consideration is destruction of all cancer cells wherever they may be, and the structure of the lower lip permits this to be accomplished with equal certainty by either radiation or surgery. Practical considerations for the use of either method are described.

There is no standardized method for treatment of the lymph channels. The writer questions the value of radiation as a curative agent in the presence of metastases and finds no proof that its prophylactic use is warranted. Surgery, when properly executed, is definitely prophylactic and in many cases curative. Radiation has a place as a palliative procedure, its best effects being obtained by interstitial radiation, preferably combined with surgical exposure of the area to be radiated.

# THE STANDARD TREATMENT OF MALIGNANT TUMORS OF THE BLADDER<sup>1</sup>

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THE frequency with which carcinoma of the bladder is encountered makes the consideration of what may be done for the unfortunate patients afflicted with this disease one of importance to every practicing physician, and especially to every urologist. In the Cleveland Clinic we have found that malignant tumors of the bladder constitute 5 per cent of all cases of malignant disease in general, and almost half (44 per cent) of all cases of malignant disease in the genito-urinary tract.

Although there is no spectacular improvement or advancement in the treatment of this condition at the present time, perhaps an inventory of the situation may offer some encouragement and renewed hope for the future in combating vesical carcinoma. There have been no striking innovations recently, but by comparing the results obtained now with those of 20 years ago, it is evident that there has been a slow but gradual improvement as the result of better diagnostic methods and of technical improvements in surgery and radiation therapy.

But the improvement in results already noted does not, in my opinion, mark the end of the road, for armed with these technical improvements and with the knowledge gained from the reviews of large series of cases, we may be able to reconsider and re-evaluate the criteria for operation with the result that more radical procedures will be undertaken in a greater proportion of cases, with consequent improvement in end results.

A more optimistic outlook regarding bladder tumors is encouraged by the facts that the bladder is not a vital organ and can be widely resected or completely removed without jeopardizing the processes necessary to life, and also that bladder tumors tend to remain localized for longer periods of time than do cancers in many other parts of the body. The records show, of course, that the proportion of local recurrences in the bladder is greater than elsewhere in the body, but this tendency could probably be corrected by earlier diagnosis, more rigid vigilance regarding examinations subsequent to operation, and by more radical treatment at the outset.

The methods of treatment of carcinoma of the bladder have included fulguration, cauterization, diathermy, radiation with radium and roentgen

<sup>1</sup>Presented in the Symposium of Cancer, being the Clinical Congress of the American College of Surgeons, Boston October 17, 1934.

there was a recurrence within a year. A second resection was done and the patient has been free of the growth for 25 years. This experience shows that a local recurrence is no contra indication to repeated attempts at excision of the growth.

In cases in which local excision or resection of a tumor of the bladder is impossible, total cystectomy may be done with the assurance of relief from the distressing symptoms attendant on an ulcerated, infected lesion in the bladder. Because of the relatively low incidence of distant metastases from bladder neoplasms, the indications for so radical a procedure as cystectomy are greatly enhanced.

Despite the indications for the procedure and the probability that the results would be as good or better than those from radical operations in other parts of the body, cystectomy has not been widely or generally used because of the technical difficulties involved. A transplantation of the ureters into the rectum is prerequisite to removal of the bladder. This operation requires a great deal of surgical skill and experience. Furthermore, the excision of the urinary bladder is no undertaking for a novice in surgery.

Much of the improvement in the method of transplantation of the ureters and cystectomy we owe to the brilliant work of Coffey. His chief modification of the technique consisted of the application of the valve principle in the transplantation of the ureters into the rectum. In his final contribution to the literature, he reported a series of 11 cases in which the bladder had been completely removed. Seven of these patients were alive and well for periods of 4 months to 5 years. His comparatively low operative mortality rate of 27 per cent and the period of freedom from recurrence made the outlook in this type of case much more promising.

Recently Dr. Charles C. Higgins of the Cleveland Clinic has made a further modification of the operation for uretero-intestinal anastomosis in which the ureters on both sides can be transplanted at the same operation, without interruption of the flow of urine into the bladder until the new channel between the ureter and bowel has been established. This method decreases the likelihood of peritoneal infection, which has been the greatest cause of death in this type of operation, and diminishes the morbidity after operation.

With these improvements in the operation, cystectomy is being performed with increasing frequency, and I firmly believe that the more generally this operation is utilized, the less will be the proportion of recurrent and metastatic malignant lesions from bladder tumors.

When, for any reason, surgical removal of the bladder does not seem feasible, fortunately an other mode of attack, radiation, is available. The application of radium and roentgen rays for the wholly inoperable cases has given results that are most encouraging, in many instances. The indiscriminate use of small or large doses of radium by persons unfamiliar with its use and action has caused condemnation of a method of great merit. The best results in radium therapy can only be obtained by the close co-operation of physicist, pathologist and clinician.

The work of Barringer at the Memorial Hospital in New York demonstrates the value of skill and experience in the use of radium for the control of bladder neoplasms. In a series of 98 cases in which the clinical diagnosis was supported by biopsy, 52.9 per cent of the patients with papillary carcinoma and 29.7 per cent of the patients with infiltrating carcinoma were alive and had no evidence of disease, according to cystoscopic examination, at the end of 3 years. Barringer feels that radium treatment is the method of choice and that the results to be expected from radiation are as good as those from surgery. The accessibility of the tumor must govern the choice of transurethral or transvesical approach, and in all instances, an attempt should be made to apply a sufficiently large primary dose to destroy the tumor completely.

The same considerations are true of roentgen radiation. Since roentgen therapy has become a special field in medicine, the results of this type of treatment have been greatly improved. Deep roentgen therapy, however, in the treatment of bladder tumors is not so effective as the application of radium. In our own experience its use has been mainly palliative, but it may give many days and months of comparative comfort to an otherwise miserable creature. The occasional remarkable symptomatic relief and local regression of an extensive growth suggests that more widespread application in less formidable lesions might demonstrate a greater field of usefulness for this type of therapy. With the introduction of higher voltage machines in roentgen therapy, it is quite possible that the results of this type of treatment might overshadow all others in malignant tumors of the bladder, especially if surgical procedures would be extremely difficult, or impossible.

Although surgical removal and radiation are respectively the most important methods of treatment in cases of carcinoma of the bladder, fulguration and cautery may still be useful in certain cases, especially in very small lesions, extremely early growths, or those of a very low grade of

1915 shows that there has been a perceptible increase in the number of 3 and 5 year cures. They reported the number of 3 year cures following resection as 14 and 25 per cent respectively. In our own series 28 per cent of the patients subjected to operation and radiation have survived for 5 years or more. A recent series of cases reviewed at the Mayo Clinic (4) reported that 28 per cent of patients with carcinoma of the bladder survived 5 years or more. The Carcinoma Registry (3) in its recent report of 902 cases numbered the 5 year survivors at 33 per cent. At the time of Watson's and Gardner's reports the treatment was limited largely to excision and partial resection, whereas today we can resort to cystectomy with increasing confidence, and have recourse also to radiation therapy—an important adjunct if not the sole hope of patients with advanced disease. Today's results are still far from what we might wish, and also, I believe, from what we may actually accomplish. With certain physiological and pathological factors more favorable than in tumors elsewhere in the body, we should face the problem of treatment of malignant disease of the bladder with new confidence that there will be a steady improvement in the final results in this type of case.

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malignancy. The important point, of course, is to destroy the lesion entirely, and if that can be done by some less radical procedure, the results obtained may be excellent. Several of our patients were thus treated very satisfactorily. Surgical diathermy has been advocated by a number of urologists, and seems to produce good results in certain cases in which operation can not be performed (7, 10). It probably has some place in the armamentarium of the urologist in certain types of cases.

## SUMMARY AND CONCLUSIONS

As has already been mentioned, most authorities agree that the incidence of distant metastasis from tumors of the bladder is considerably lower than from other neoplasms. The Carcinoma Registry of the American Urological Association (3) has estimated that metastasis occurs in only 10 per cent of the cases. Other estimates have placed this figure at 20 per cent or even higher. Some writers have contended that the incidence of metastasis depends on the degree of malignancy of the lesion (7). In view of these statements, the report of Smith and Alpert is most interesting, for they state that in a study based on 34 post-mortem examinations at the Massachusetts General Hospital, metastasis was revealed in 16 instances, or almost 50 per cent. Their demonstration that the tendency to metastasize is not related to the grade of malignancy is significant and indicates clearly the necessity for regarding every case of tumor in the bladder as either potentially or actually cancerous.

The Carcinoma Registry found in an analysis of 902 epithelial tumors of the bladder that there had been a recurrence in 46 per cent of the cases (3). They also have pointed out that the incidence of metastasis is higher in cases in which the tumor is most easily resectable, that is, high in the vault of the bladder. Most of these tumors were found to metastasize to the liver, because of the direct pathway through the lymphatics of the hypogastric vessels. These facts emphasize the necessity for increased vigilance in following the course of each patient after operation and also show that more radical operations probably are indicated and might produce very much more satisfactory results. In conclusion, although I have no revolutionary procedure to advocate in the treatment of carcinoma of the urinary bladder, I feel that we should all be heartened by the evidence of the gradual development which has already been accomplished. Merely to contrast the results in a few relatively recent series of cases with those

# SYMPOSIUM· TREATMENT OF FRACTURES

## ONE THOUSAND CONSECUTIVE FRACTURES OF BOTH BONES OF THE LEG<sup>1</sup>

WILLIAM SENGER M.D. F.A.C.S. AND J. SIMS NORMAN M.D. F.A.C.S. PUEBLO COLORADO

**T**RAUMATIC surgery has come into its own. The wonder of it all is that it required the tragedy of a World War to focus our attention on the importance of this branch of medicine. As a specialty it lagged because the general practitioner treated trauma as a side issue—a bore and a hazard. He gave little thought to its importance and little study to its anatomy, pathology and end results. The War forced the issue. Expansion of industry, development of automobile and airplane have broadened the field and sharpened the interest of our profession. Traumatic surgery now challenges the attention of our manufacturing plants, great and small. Industrial Commission awards which have been based on both anatomical and functional perfection in the results of fracture treatment have spurred this newer surgery forward. It is for this reason that the evolution in fracture treatment has had to be rapid. There has been much room for progress.

In a review of 1,000 consecutive fractures of the tibia and fibula covering a period of approximately 17 years one's mind passes in review the numerous examples of cumbersome and expensive, beautiful and worthless reduction apparatus which clutter our basements. Gradually, simpler and better tools made their appearance. To be successful these appliances must be the result of sound physiological, reconstructive and rehabilitative reasoning.

When invited to present a paper at this meeting we felt that some of the rather obvious things in this group of cases would be interesting—possibly instructive.

We see many fractures, because the Corwin Hospital is the concentration point for diseases and injuries of the Colorado Fuel and Iron Company employees and their dependents. Our company operates a large steel plant in Pueblo, iron mines in Wyoming, coal mines and lime quarries throughout Colorado. All fractures of any consequence are splinted by the local physician and sent to us.

In considering fractures of both bones of the leg as an entity we note—

1 That this is a very frequent industrial injury.  
2 That no other major fracture is compounded so frequently. This is due to the close proximity of the bones to the skin and to the terrific force required to fracture both bones.

3 That the site of fractures from direct violence is most frequently at the weakest point—the point between the middle and lower third of the leg. Fractures due to indirect violence are often of the spiral type.

4 That no other fractures are so prone to non union. It is our opinion that muscle attachments with their rich blood supply have much to do with bone union. There is an absence of such attachments in the region of the middle and lower third of the leg. Besides, when fractured, the ends of the fragments usually are separated completely from surrounding tissue. If our original assumption be correct, it readily explains non union in this situation.

5 That any trauma of sufficient force to fracture both bones usually greatly damages the soft parts. Sometimes our efforts are concentrated, therefore, on the co-existing surrounding injuries rather than upon the bones themselves.

### TREATMENT

In the time allotted we must be dogmatic and not argumentative. Whatever we have found of greatest value is here described.

1 Every severe fracture case is potentially or actually in shock. No reduction should be attempted until this complication is alleviated.

2 If not contra indicated, the fracture should be reduced immediately and plaster cast applied. In the simplest fractures with little displacement we use local anesthesia. Even in these cases, however, we must have the active co-operation of the phlegmatic patient. Spinal anesthesia is ideal if we bear in mind its contra indications. But our main reliance has been placed on nitrous oxide and oxygen with ether. Generally speak

<sup>1</sup> Presented in the symposium on the Treatment of Fractures before the Clinical Congress of the American College of Surgeons, Boston, October 16, 1934.

ing, either gives the greatest relaxation with the least hazard

When the fragments are so fixed that we feel it practicable, a Boehler walking iron is incorporated in the cast. One of us (S.N.) became enthusiastic about this method after visiting the Boehler clinic. Further study, however, makes us believe that it is not safe to use it as routinely as Dr. Boehler does.

3. Theoretically, every compound fracture should be made a closed fracture through immediate surgery. Unfortunately, the trauma may seriously damage blood vessels and nerves, de-vitalize the skin muscles, tendons, fat, and fascia. Our first investigation, therefore, should be concerned with the viability of the limb as a whole. Then our attention should be directed to the sterilization of the surrounding skin—shaving, scrubbing gently with soap and water, bathing in ether, and finally applying tincture of iodine. All of this should be done with meticulous care so as not to contaminate the open wound with foreign substance. Next the wound is washed thoroughly with large quantities of saline solution. Tincture of iodine is then poured into the wound. While we do not feel that iodine will sterilize the multitude of crevices open to infection, we believe it should always be used. It probably helps. Apparently it does no harm.

Mechanical sterilization, however, is of the greatest importance. The skin edges are cut away. All devitalized tissues, whatever their character, must be removed by sharp dissection. Constantly we watch lest the scalpel graft potential infection into clean tissue. Of late we have performed debridement with the "radio knife"—much to our satisfaction.

Sometimes, in severe wounds, it may be almost impossible to trace all small crevices. Here we have found it of advantage to counterstain with methylene blue. The tracts may then be followed as is done so frequently in ramifying fistula elsewhere in the body.

If the bones have been ground into dirt the ends are trimmed. Pieces of entirely detached bone are removed. Adherent fragments are placed in a position most advantageous for healing. Thus do we carry out debridement, with no finger contact technique.

The next step is to suture the severed soft parts, nerves, tendons, and muscles. Absolute hemostasis must be the rule. The skin is sutured without tension. If it cannot be approximated, relaxation is accomplished by longitudinal incisions some distance from the wound. The skin is never undermined. Drainage is never inserted.

Extension is always applied by the skeletal method. We use almost routinely the Steinmann pin, rarely ice-iron calipers or Kirschner wire. TrACTION is followed by applying a plaster cast. Markedly comminuted fractures or those in which we are not able to reduce early are treated by skeletal traction. For these we prefer a small Steinmann pin through the os calcis and a Hawley suspension spring. It must be emphasized repeatedly that overtraction separates fragments and produces non-union.

5. While it is our policy to avoid open reduction when possible, we open spinal fractures of the tibia with the Bula broken high. We believe to a minimum.

6. We prefer to use autogenous substance in our open reductions and almost never use non-absorbable material. Metal plates have been used with some excellent results, but experience urged us to abandon them.

7. During the recent past we have used an automatic device designed by Dr. Roger Anderson of Seattle. This apparatus we believe is a most excellent tool for proper fixation of fractures of the leg. It is based upon simple anatomical principles with ample traction and facilitates manipulation. It does not interfere with the application of plaster and leaves the bones transfixed. Since it can be easily autoclaved, we have found this apparatus particularly helpful in our open work. Even with this apparatus let us emphasize once more the importance of preventing overtraction. Sometimes we have accused ourselves of ultra-conservatism in our attempts to save shattered limbs. How much simpler and easier to amputate! After months of constant treatment we may have a patient with a 50 per cent or even 25 per cent functioning limb. However, we have the satisfaction of knowing that psychologically this patient is far more of a man than were he to possess the best artificial limb that money can buy.

Of the 11,762 fractures treated at Corwin Hospital since 1917, 1,000 were fractures of both bones of the leg.

In reviewing these cases we find a comparatively high proportion compound, namely, 231. These were treated along the lines already set forth. In spite of these efforts 21 of them became infected, 31 failed to unite and subsequent bone graft was indicated. It was also necessary to reduce 54 fractures of other types by open method. Amputation was necessary in 11 cases. These should probably not be considered here because of the primary seriousness of their injury. In the 1,000 cases there were 19 deaths. These were all

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In the time allotted we must be dogmatic and not argumentative. Whatever we have found of greatest value is here described.

- 1 Every severe fracture case is potentially or actually in shock. No reduction should be attempted until this complication is alleviated.
- 2 If not contra indicated, the fracture should be reduced immediately and plaster cast applied. In the simplest fractures with little displacement we use local anesthesia. Even in these cases, however, we must have the active co-operation of the phlegmatic patient. Spinal anesthesia is ideal if we bear in mind its contra indications. But our main reliance has been placed on nitrous oxide and oxygen with ether. Generally speak

<sup>1</sup>Presented in the symposium on the Treatment of Fractures, before the Clinical Congress of the American College of Surgeons, Boston, October 16, 1934.



results are actually impossible. In many other cases, however, poor results may be due to the following factors:

1. Insufficient anatomical reduction because of inadequate equipment
2. Insufficient care of the wound followed by infection in open fractures
3. Numerous vain attempts at conservative treatment in fractures which are of such a nature that perfect anatomical and functional results can be obtained only by operative intervention
4. Lack of skill and experience in the technique of operative treatment of fractures
5. Hasty hospitalization of poorly set fractures, with consolidation in incorrect position and permanent injury due to subsequent incorrect position of the adjacent joints
6. This latter fact receives too little attention, not only from the general practitioner but also from the surgeon in some cases. The fracture must not be looked upon as an isolated injury but the bone, the muscles, and the adjacent joints must be considered as a functional and physiological unit.

In injured patients psychological factors must also be held partially responsible for unsatisfactory results. There are cases in which the anatomical position is perfect but the patient develops compensation neurosis and the result is functional impairment of the condition.

We will now describe briefly, on the basis of the extensive fracture material of the surgical clinic of the University of Freiburg (Germany), the methods by which we achieved the best results in operative treatment of fractures of the long tubular bones. Purposely very few figures will be given because statistics give little information concerning the ways and means by which good results are obtained in the individual case. Table II covers the fractures treated during a period of 7 years.

TABLE II

Total number of fractures treated	
Operatively treated	11,000
Treated in clinic (hospitalized)	1,245
Bone plating	75
Percent	100.00
	9.37
	5.4
	0.63

It will be noted, therefore, that of 12,000 cases 1,245, or 10.37 per cent, were hospitalized. Of these 1,245 cases 306, or 24.58 per cent, i.e., approximately one-fourth, were treated by operation. In this latter group there were 75 cases, or 24.5 per cent, in which plastic repair was done by means of bone plates. Let us also consider a few data concerning the frequency of fractures of the long tubular bones and their skeletal distribution. Table III shows

These figures show clearly the frequency with which fractures force the physician to be particularly exact in the matter of indications. The type of anesthesia, the time of operation, the operative technique, and the preliminary and after-treatment are all important factors in the individual indication. A brief review of each of these points is given in the following sections.

### MARCOSIS OR ANESTHESIA IN OPERATIVE TREATMENT OF FRACTURES

If the type and location of the fracture and the procedure to be used in treatment are such that the physician can manage without general anesthesia, local anesthesia should be used. In extensive interventions—bone plating for instance—in psychically unstable patients, general anesthesia should always be given. In fractures of the lower leg in which operative reduction is easily accomplished by approximating the fragments with a hook, local injection is sufficient. When there is to be applied to fractures of the lower leg and of the thigh we frequently use lumbar anesthesia. In cases in which the fractured bones lie close to the surface we occasionally inject novocaine at the point of fracture, as recommended by Boehler. In the upper extremity one can sometimes use Kulemperoff's plexus anesthesia. We have frequently used it with good results but in a few instances the results were unsatisfactory. Koenig urgently recommends cross-sectional and anesthesia, in which radial injection down to the bone is done at 4 or 5 places about a handbreadth above the region of operation, so that the novocaine solution acts upon the perosteum, the muscles, and the skin. Infiltration must be done also along the line of incision. In operations which can be completed within a short time I have recently begun using intravenous Eupivan anesthesia, especially in fractures of the lower leg, in some cases local anesthesia is combined with it. This combined method has shown itself to be excellent.

Details about this combination of local and intravenous anesthesia in fractures are being published in *Anaesthesia and Analgesia* 1935 March.

## TIME OF OPERATION

Another important factor in good operative treatment of fractures is the time at which operation is performed. With the aid of examples let us now study a few types of fracture, in some of which immediate operation is indicated, while in others, later operation is advisable. Of course we do not pretend to cover all possible types of fracture.

Immediate operative intervention is indicated in only a few cases:

1 In complicated, severely dislocated fractures of the lower leg. At the time of primary excision and wound treatment the misplaced ends of transverse fractures are approximated with a hook; after conservative reduction has been found impossible.

2 In simple or compound, badly dislocated transverse and spiral fractures of the lower leg in which correct position cannot be achieved by immediate closed reduction.

3 In fractures of the forearm in which the dislocation of the 2 bones frequently cannot be corrected by closed reduction. Here it is often a matter of transverse fracture of the shaft, in which reduction may readily be accomplished by simple approximation.

4 In fractures whose dislocated fragments induce injury to nerves or vessels. In such cases operation sometimes shows the nerve riding upon the pointed fragment.

5 In joint fractures.

6 In cases with large fracture hæmatomata which may induce severe compression of vessels and nerves (ischæmia). This is known to occur in fractures of the elbow. Immediate relief should be given by splitting of the fascia, drainage of the hæmatoma, correction (with wire suture if necessary), etc.

In other words, the above types of fracture are those in which operative treatment should be given immediately. They are fractures lying superficially in which either conservative reduction is not possible or the associated skin injury demands operative treatment even though other soft parts are not particularly injured, and finally this group includes fractures in which the associated injuries are such as not to permit delay in treatment of the fracture until the most convenient time.

In all other cases we usually look upon the second week as the optimal time for operative treatment of the fracture. Koenig, Lambotte, Rehn and others are of the same opinion and operate about the beginning or the middle of the second week. Lexer designates the fourth and fifth as well as the second week as favorable. He

bases his opinion upon his investigation which showed that fracture hyperæmia is most highly developed during this period. Doubtless the choice of time for operation is dependent upon the physiopathological processes which occur in connection with the fracture trauma. Along with the degenerative changes in bone, lacerated periosteum, and damaged muscles, which occur immediately after injury, there soon appear regenerative processes of which the surgeon makes use. In this connection the physiological response of the muscles plays a part which often is overlooked. The physiological balance of the muscle tone between flexors and extensors is a necessary factor in the healing of fractures. This is achieved only by firm fixation of the broken bone in good position. Immediately after fracture the muscles involved are in a state of subnormal excitability, which persists for about 8 days and is designated as a sort of "muscular stupor" (Rehn). Then from the eighth to about the thirtieth day after fracture there is a state of "intermittent tetanic hyperexcitability of the muscle." The correlation between the fracture and the muscle is of outstanding physiopathological importance. This muscular activity is necessary in all of those places where the callus must be furnished by the periosteum alone, i.e., in the diaphysis. It is encouraged by absolute rest of the injured member and extension according to physiological condition. Insufficient rest and too great a degree of extension prevent physiological activity of the muscles (electric action currents) and so defer callus formation. This retards healing of the fracture or prevents it entirely.

The large number of pseudarthroses or non-united fractures observed during the last few years is due partly to the fact that the fractures were not fixed firmly enough and were not left in the plaster long enough, or to the use of too great extension.

## INDICATIONS

It is erroneous to suppose that operative treatment of fracture is permissible only after long use of conservative measures has proved useless. By postponement of necessary operative correction conditions may be created which impair the operative result or even make a perfect result impossible. We must see to it that operative treatment is given at a timely period in all cases. Operation should be done before the regenerative capacity of the fractured bone is exhausted and before retraction, contracture, atrophy of the muscles, and contractions of the capsule and ligaments of the adjacent joints have induced permanent injury.



Fig. 1. Spiral fracture of the lower leg with severe displacement and interposition of musculature. When conservative measures failed operative reduction and suture with metal bands was done according to the method of Parham.

Fig. 2, left. Oblique fracture of the thigh with severe dislocation and impalement of the soft parts. When conservative measures failed operative reduction was done.

Fig. 3. An ideal anatomical result was obtained by winning tissues. This increases the danger of slight or late callus formation and of subsequent pseudarthrosis.

2. In fractures in which muscle interposed in the fracture makes conservative reduction impossible from the beginning.



Fig. 4. 14 year old boy, osteitis fibrosa generalisata (Recklinghausen's disease) in the upper and lower end of the right femur and in the upper end of the left femur. Fig. 5. Operative reduction and fixation of the right femur by metal splint fastened laterally to the bone with 4 wires. In spite of the pathological change in the bone the picture shows adequate callus formation. Splint and wires are firmly embedded and healed over. Condition 3 months after operation.

1. When conservative measures have failed in spite of the use of all technical devices such as fracture table, countertraction, wire extension, etc. Numerous manipulations repeated at short intervals, contusions, and traction on the soft parts injured by the fracture enlarge the hematoma and disturb the physiological repair of the

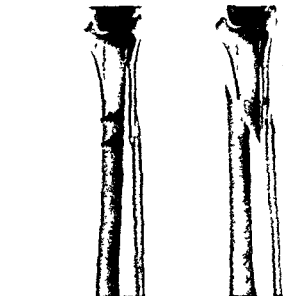
#### OPERATION IS INDICATED

experience describe the effective operative treatment apply to individual cases and on the basis of our We will now discuss these indications as they

(3) when consolidation fails to occur closed fixation of the fragments is impossible, and reduction cannot be accomplished, (2) when

Generally speaking operative treatment of fractures is indicated (1) when perfect anatomical reduction cannot be accomplished, (2) when closed fixation of the fragments is impossible, and (3) when consolidation fails to occur. We will now discuss these indications as they apply to individual cases and on the basis of our experience describe the effective operative treatment.

the fractures. e, 24.58 per cent, or practically one fourth of we have a much higher percentage of operations, if we consider the number of hospitalized cases fractures must receive operative treatment. But



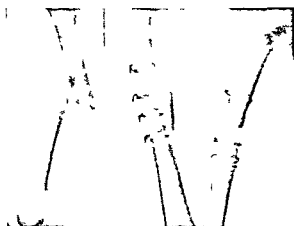


Fig 7

Fig 8

Fig 9

Fig 7 Transverse fracture of the thigh in a man aged 25 years. Attempt at reduction by means of extension plaster cast and wire traction was unsuccessful. The fragments were angulated due to muscular traction and interposition of soft parts. There was weakness of the callus with danger of pseudarthrosis.

Fig 8 For this reason the fracture was exposed and plated with a plate of bone from the tibia. Excessive proliferation of the callus on the medial side of the shaft.

Fig 9 Fracture after 8 months. It is in good position and well healed. The transplanted bone is firmly fused with femur. The marked callus proliferation has receded.

3 In cases of interposition of tendons for instance the long biceps tendon which in some instances constitutes an absolute hindrance to closed reduction.



Fig 12

Fig 13

Fig 14

Fig 12 Severe double fracture of the shaft and neck of the humerus. Conservative reduction failed.

Fig 13 Condition 6 years after operative treatment. Splinting of the shaft fracture with autoplasmic plate of bone from the tibia. The fracture is firm, the transplanted bone and the wires have healed over without reaction.

Fig 14 The head of the humerus which was broken off completely was wedged into position by open operation. It is firmly healed and there is perfect function.



Fig 10 above Man aged 65. Spiral fracture of the humerus with complete separation of a large fragment of bone. Closed reduction unsuccessful because of interposition of muscles.

Fig 11 Condition 7 weeks after operative treatment. The fragments were held in position by wiring.

4 When there is injury to a nerve or a vessel due to impalement upon a sharp fragment whose immediate closed reduction could not be accomplished.

5 In cases of transversely placed or interposed fragments of bone which must either be removed or replaced in their anatomically correct position. In fractures of the lower leg the tibia may constitute a hindrance to reduction. If the fragments

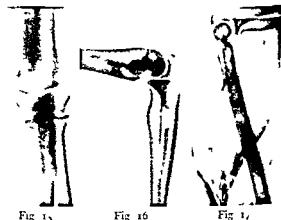


Fig 15

Fig 16

Fig 17

Fig 15 Longitudinal fracture of the lower end of the tibia with penetration of the elbow joint.

Fig 16 Angulation and dorsal displacement of lower fragment.

Fig 17 Ideal anatomical reposition was obtained by small dorsal incision and wiring.

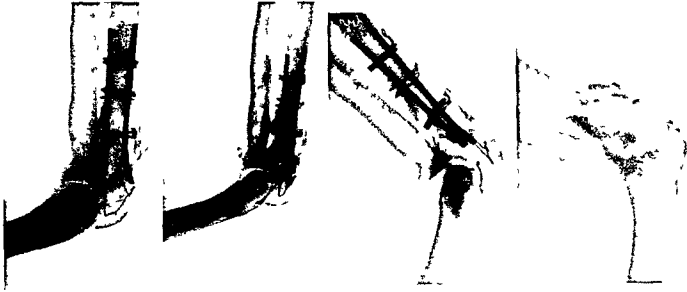


Fig 18

Fig 19

Fig 20

Fig 21

Fig 18 Comminuted fracture of the elbow in a man, aged 30 years, numerous fragments of the olecranon and the ulna with dislocation of the head of the radius. Fig 19 Operative exposure by dorsal incision in the forearm, opening of the joint and wire suture through the lateral metal splints.

of the tibia cannot be reduced and placed one upon the other because of interference from the fibula, a piece of the latter must be resected.

6 In cases of transverse fractures of the upper arm and thigh, in cases in which perfect position cannot be achieved by extension with Kirschner's wire or leucoplast, etc. In this group should be placed also the oblique fractures and spiral fractures of the femur, whose reduction is rendered difficult by the thick masses of muscle of the thigh. As a general thing one attempts to obtain

reduction with traction more frequently in the upper arm than in the thigh because the danger of operative injury is doubtless greater (injuries to the radial and the axillary nerves, atrophy of the deltoid muscle, etc.)

7 In fractures of the forearm The relative frequency of inadequate consolidation in these fractures is well known. In this group pseudarthroses are most readily avoided by exact operative reduction, if conservative measures do not succeed.



Fig 22

Fig 23

Fig 22 Fracture of the radius with separation of the epiphysis and dorsal displacement.  
Fig 23 Small dorsal incision over the wrist joint, return of the epiphysis to position and fixation with wire suture.



Fig. 24 left: 9 year old child: oblique subcapital fracture of the neck of the humerus

Fig. 25: Operative exposure: fixation of the fragments with laterally placed metal: plant firmly fastened with 2 wires. Distinct callus formation. The fracture is firm at end of 6 weeks.

8 In cases of delayed callus formation due to laceration of the periosteum or inadequate vascular supply as a result of laceration of the nutritive artery. In these cases operative freshening of the fractured ends may produce the desired results.

9 In pseudarthroses (non united fractures). Here operative intervention is the only therapy which can produce results.

#### TECHNIQUE

As a matter of principle we operate upon fractures without the use of a tourniquet in order to avoid secondary hyperæmia and hæmatomata. We prefer exact hæmostasis in the tissues. Rapid incision through skin, fascia, muscle and periosteum is the most sparing to the tissue. Large incisions are necessary for the most careful exposure of the bone. In the thigh we prefer to place the incision on the lateral side at the anterior border of the musculus

tensor fascia lata, in the lower leg we use a longitudinal incision a fingerbreadth lateral to the anterior border of the tibia. In the upper arm we use either Langenbeck's resection incision or the Dollinger incision at the medial border of the deltoid muscle. Longitudinal incisions through the deltoid muscle may lead to atrophy and motor disturbances and should therefore be avoided. The soft parts are not held aside with sharp hooks but with blunt retractors. Care should be taken not to separate the periosteum from the muscle because this might result in nutritional disturbance to the periosteum and subsequent weakness of the callus.

In the following we shall give a few cases which we operated upon in our clinic. Technique, indications and results are shown more distinctly by a few examples than by statistical tables.

Among the fractures of the lower leg we have (Fig. 1) a spiral fracture of the tibia with severe dislocation, together with impalement and interposition of the muscles. Conservative measures were unsuccessful. Therefore two small metal bands were applied according to Parham Patti technique. The condition before and after operation is shown in the picture.

In many similar cases we have obtained fixation of the fragments by simply winding two wires about them.

In fracture of the thigh we use different methods according to the individual case. In spiral and oblique fractures retention and fixation of the fragments can be obtained by wire suture applied after reduction to anatomical position (Figs. 2 and 3). If setting fails because of slipping of the fragments we must consider using splints of either autogenous or foreign material. As a general thing we do not approve of drilling through the bone and applying numerous screws as some surgeons recommend. According to our opinion



Fig. 26

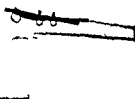


Fig. 27



Fig. 28

Fig. 26: 10 year old boy: transverse subcapital fracture of the humerus.

Fig. 27: Two metal plates are fastened with 3 wires over the site of the fracture. Because of the shortness of the proximal fragment simple wiring of the fracture would not

have held. Consequently three canals were drilled into the bone and the wires were passed through them.

Figs. 27 and 28 show the position of the metal plates and the position of the fracture from the front and from the side.

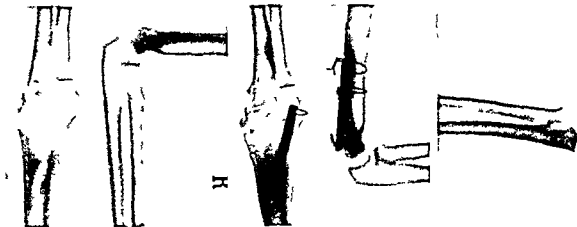
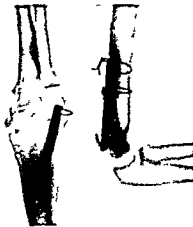


Fig 29

Fig 29 Patient was a girl 13 years old, who suffered a supracoracoid fracture of the humerus with severe distal displacement and interposition of the soft parts. Large haematoma. Conservative measures unsuccessful in effecting a satisfactory union.

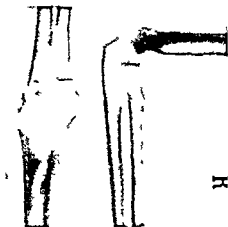
Fig 30 I lateral dorsal incision over the elbow joint, correct reduction of the greatly displaced fragments, fixation by application of metal splint firmly attached by wiring. Fig 31 Removal of the splint and wire after 2½ months. Very good anatomical position.

Fig 30



K

Fig 31



In this case, as shown in Figure 6, operative reduction of the fragments was done, fixation was accomplished by metal splint with wire sutures. The case is worthy of note because it shows that even bone with pathological changes healed without reaction over the stainless steel splint which we used. We examined the boy half a year later. The fracture was firm and the foreign body was healed over with such complete absence of reaction that we decided not to remove it.

The metal splint technique just mentioned as especially successful in youthful patients with transverse shaft fractures which cannot be treated successfully with conservative extension therapy. In vigorous individuals, however, even this splinting may be too weak for the strong musculature

drilling through the cortex in a number of places and on both sides of the bones injures even the normal bone, and this injury would be all the more marked in a bone which has suffered a recent fracture and is in the process of destruction and regeneration. Therefore, in lateral splinting, we apply a new narrow perforated splint of stainless steel and fix it in position with 2 or 3 wires, much the same as in simple wrapping with wire. You see a result of this treatment in Figure 6. This picture is of interest also because it shows a generalized osteitis fibrosa (Fig 4). You will see a number of foci in the right and left thighs. This same case showed fibrous bone foci in both upper extremities also. This 14 year old boy suffered a spontaneous fracture which you see in Figure 5.



Fig 32 left above Complete extension in pronation  
Fig 33, left below Normal extension in pronation  
Fig 34 right Normal flexion

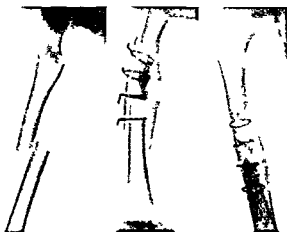


Fig 35

Fig 36

Fig 37

Fig 35 Transverse fracture of the thigh with interposition of musculature and soft parts in an 8 year old boy. Attempts at conservative reduction failed.

Fig 36 Operative exposure of the fracture attachment of a splint of bone from the tibia and fixation with 4 wires. Condition 6 weeks after operation excessive callus formation the plate is partly healed over at the upper end.

Fig 37 Lateral picture perfect anatomical position large callus at the medial side of the shaft.

of the thigh. In such cases we prefer the stronger splinting by free autoplasmic transplantation of bone taken from the tibia. This method was developed by Lexer. In our series of 12 000 fractures we have used it 75 times in the course of 7 years. It is important that the bone splint be of sufficient length and thickness and be fixed with absolute firmness to the fragments with wire. Figures 7, 8 and 9 show clearly the result of such operative repair in the thigh. The method can be used with excellent success in severely dislocated transverse fractures and especially in non united fractures (pseudarthroses). Even though in beginning pseudarthroses freshening and drilling of the fragments (a method originally devised by Dieffenbach and recently revived by Beck) produces the desired effect there are still numerous cases which will respond only to the bone splinting method just described. Absolute immobilization for 10 to 12 weeks is indispensable in these cases. Of course the foreign body must be allowed to remain longer in these cases because it fixes the bone splint. In most cases the wires become firmly embedded in the splint and in the parent tissue and heal over so that their removal is not necessary.

A further case showing the indication for wire suture in comminuted fracture is illustrated in Figures 10 and 11. A man aged 65 suffered severe trauma resulting in spiral fracture with separation of a fragment of bone. The fracture

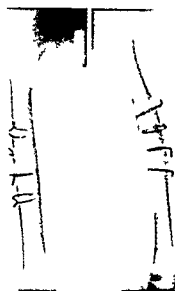


Fig 38 Shows the condition of the bone after 8 months. Very good anatomical position of the femur the fracture is firm the plate of bone and the wires have healed over without reaction.

was sutured with wire and showed ideal position of the fragments 7 weeks later.

This is the case of a girl aged 21 who suffered a severe comminuted fracture of the upper arm (Fig 12). There was a fracture in the middle of the shaft and another splintering comminuted fracture at the surgical neck of the humerus. Here neither extension nor other reduction maneuvers could produce good results. We therefore used an autoplasmic bone splint for the fracture of the shaft and impaction for the subcapital fracture of the humerus. The two control pictures (Figs 13 and 14) show the anatomically perfect result after 6 years. The fractures are firm the bone splint and the wire healed over without reaction and clinically there are no essential functional limitations.

The next case (Figs 15 and 16) shows a longitudinal fracture of the lower end of the humerus involving the elbow joint. If such a joint fracture is not reduced to perfect anatomical position it induces secondary arthritis deformans. For this reason operative reduction of the fracture was done. By means of a dorsal incision ideal position of the fracture and of the joint was obtained with only one wire suture (Fig 17—after operation in plaster).

In the next case (Fig 18) we have a severely comminuted fracture of the elbow joint. If such a case is treated by conservative measures there will be stiffness of the joint. Here the shattered





Fig. 39 Normal extension 8 months after operation  
Fig. 40 Flexure of the knee joint after operation  
Fig. 41 Efficient functioning of the joints of the fractured lower extremity

Fig. 41

Fig. 40

Fig. 39

Figure 24 illustrates a transverse subcapital fracture of the humerus in a 9 year old boy. Here even the type of fracture shows that neither conservative treatment nor simple wrapping with wire could have achieved firm fixation of the fracture. For this reason (Fig. 25) a metal splint was sutured upon the fracture and fastened with 2 wires. Anatomical position and function of the humerus were perfect.

In a similar case of subcapital fracture of the humerus in a 10 year old boy a variation of this technique was used. Three canals were drilled through the fragments and 2 metal splints were wired in place, one to either side of the humerus (Figs. 27 and 28). Fixation of the metal splints by means of drilled canals is necessary only in cases like this because if the wire were merely passed around the bone without a drilled canal the wire would slip off because of the shortness of the proximal fragment.

Supracondylar fractures of the elbow cannot always be reduced perfectly by conservative measures. If closed reduction fails, as in the case of this 13 year old girl (Fig. 29), the fracture must be exposed and operative correction must be performed. In this case there was separation of the entire joint surface of the lower end of the humerus, it was attached to the shaft of the humerus by means of a metal splint and 3 wire sutures, as you see in Figure 30. After 10 weeks the splint and wire suture were removed. Figure 31 shows a perfect anatomical reconstruction of the elbow joint, when conservative measures fail.

Bone fractures in children usually should receive conservative treatment, but there are cases in which even children's fractures justify or even demand operative therapy. During the last few years open reduction has been necessitated in many instances by the increasingly frequent serious traffic accidents which cause severe types of fracture, such as formerly were hardly known. Mastery of the operative technique of fracture treatment makes it easier for the surgeon to make up his mind to operate even in youthful patients.

Figure 22 shows a fracture of the radius in which the entire epiphysis was split off and displaced dorsward. If such a case is treated conservatively the wrist becomes stiff. Through a small incision one can bring the epiphysis back to the shaft of the radius and fix it there with a single wire suture. Clinically the wrist is shown in Figure 23.

Figure 22 shows a fracture of the radius in which the entire epiphysis was split off and displaced dorsward. If such a case is treated conservatively the wrist becomes stiff. Through a small incision one can bring the epiphysis back to the shaft of the radius and fix it there with a single wire suture. Clinically the wrist is shown in Figure 23. The perfect anatomical result is shown in Figure 23. Clinically the wrist showed normal function. Bone fractures in children usually should receive conservative treatment, but there are cases in which even children's fractures justify or even demand operative therapy. During the last few years open reduction has been necessitated in many instances by the increasingly frequent serious traffic accidents which cause severe types of fracture, such as formerly were hardly known. Mastery of the operative technique of fracture treatment makes it easier for the surgeon to make up his mind to operate even in youthful patients.

and Figures 32, 33 and 34 show the ideal functional result (complete extension, complete pronation and supination, and maximal flexion).

Fractures of the femur in children, especially transverse fractures, may likewise fail to respond to conservative treatment as is so often the case in adults. In a series of 90 fractures of the femur in children which I reported in a recent article there were 8 cases in which we were forced to use bone plating in spite of the youth of the patients, all were transverse fractures of the femur. Figure 35 shows the transverse fracture in an 8 year old boy. Figures 36 and 37 show the condition 6 weeks after operation with bone plate wired over the fracture. You see the end result after 8 months in the next picture (Fig. 38). Bone plate and wires have healed over without reaction and the anatomical position may be designated as ideal. The normal functions of the thigh and of the joints are shown in the next pictures (Figs. 39, 40, and 41).

Of interest in all of these cases is the formation and resorption of the callus. As a general thing we may say that the poorer the position of the fracture the more callus is necessary for rebuilding the normal structure of the bone and the better the position the less callus is needed.

As you will gather from the facts just given we may say that the results of the operative treatment of fracture are good. On the basis of my observations in 12,000 fractures in the course of the last 7 years, and with the aid of various examples I have given the indications for and the technique of operative treatment.

It is not our intention to minimize the importance of conservative treatment of fractures in emphasizing operative therapy. It produces equally good results within its realm of indications. But the difficulty lies in the exact definition of the limits of operative and non-operative methods. Only experience with a large number of cases can teach us when it is permissible to use the conservative method and when the operative method must be used. Neither of them is in itself the method of choice.

In art there are various styles in surgery there are various methods. Both have an analogous purpose—the creation of a work of art. Neither style nor method in itself is good or bad. The

intuition and technique of the artist will create a masterpiece with any style, whether classical, baroque, or modern. With a correct grasp of the method which is indicated in the individual case and complete mastery of its technique the surgeon will be able to create a masterpiece with conservative as well as with operative measures.

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# FRACTURE OF THE (NAVICULAR) CARPAL SCAPHOID<sup>1</sup>

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cases a very fine fissure fracture is often overlooked by physicians unfamiliar with them, and if not treated a heavy line of absorption is evident within a very few months. The following case shows this condition plainly.

CASE 1. T C, aged 34 years, laborer, injured his wrist May 20 1932, lifting a roll of paper. Roentgen films showed a fissure fracture and the patient was treated with baling and massage. He was out of work practically 4 months. In July, 1933, he was re-examined because of the condition of his wrist, namely, pain, weakness, inability to push or to flex wrist dorsally. The film taken at that time showed marked absorption almost to the extent of cavity formation. Operation was advised, but the patient was unable to make up his mind.

Recent fractures seen early and properly treated do rather well as a rule. These cases, properly treated, showing a poor result at the end of 3 to 4 months or more, should be operated upon at that time inasmuch as they will get progressively worse. In complicated cases with separation of the fragments, early removal should give a favorable result.

## TREATMENT

Recent cases in good position are best treated by immobilization and rest, with the hope that bony union will occur. There is considerable difference of opinion as to just how the hand should

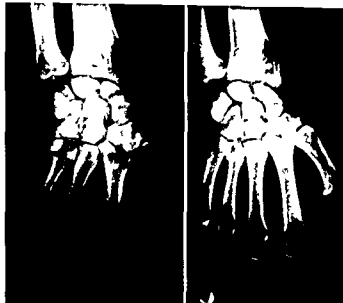


Fig 1, left T C, May 20, 1932. Fissure fracture of scaphoid.  
Fig 2. Same patient, July, 1933, showing line of absorption with question of cavity formation.

FRACTURES of the carpal scaphoids, while apt to be very crippling to the individual unfortunate enough to have sustained one, have up to comparatively recent times received very little attention from general practitioners, X-ray men, and surgeons alike. Many of these doctors without an X-ray, erroneously, as sprains, until too late to be given the proper treatment. The writer believes that these cases are worthy of more consideration and brings to the attention of those interested in this work a method of treatment that is apparently working out well, with a view to stimulating others to use it.

## SYMPTOMS

"This is one condition that 'runs true to form' inasmuch as most of the cases have almost identical complaints. Chief and foremost is pain at the site of fracture, disability and pain on pushing, limitation of dorsal flexion, local tenderness, and a marked weakness of the wrist as a whole. Occasionally there is a poor grip but this is usually the exception.

## PROGNOSIS

From a clinical standpoint the unrecognized or tardily recognized fracture offers a progressively poorer prognosis in direct ratio to the length of time since fracture. Many, in fact most of these cases, are seen in the younger age groups and are most crippling, far more so than the average group of 37 cases reported by the writer in 1929 from the Out-Patient Department at the Boston City Hospital showed over 60 per cent to be 30 years of age or less. If bone absorption, cavity formation, and local irritation with new bone formation have started, it may be possible to check this by operating upon the scaphoid, i e, either removing part or all of it or by the grafting operation. It has been clearly shown by experience that the removal of the scaphoid has not produced a satisfactory result in all cases, hence the resort to the graft. The cases with old fractures, however, offer a poor prognosis. These old cases are often crippling, many of them giving a practically stiff wrist with chronic weakness and pain. In all fairness I think it can be said that in some of the recent cases good results occur with or without treatment and that in some of them progress is poor regardless of the treatment. In many recent

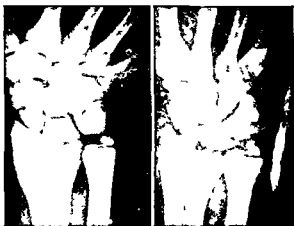


Fig 3 X Y December 10 1932 and December 20, 1932

be held at this time many using the cock up position and many others using the reverse i. e., slight volar flexion with radial flexion. Many years ago while working with Dr. Cotton and Dr. Berlin this phase was studied at length and the conclusion arrived at that the cock up was preferable, this being particularly desirable in the event of stiffness of the wrist, the position of choice for an ankylosed wrist being in extension. Dr. David Berlin working on the cadaver has shown that the cock up position gives better apposition. In putting these cases at rest the plaster of paris cast is used instead of the ordinary cock up splint. This fixes the wrist, does not require adjustment when properly applied and insures the patient of a continuance of the treatment. Many times with the cock up splint these patients give up the treatment at the end of 2 to 3 weeks and are never seen again.

Immobilization regardless of how obtained should be maintained for at least 6 weeks followed by baking and massage for a few weeks. Too much emphasis cannot be placed on the need of 6 weeks immobilization, less time in my opinion, being entirely inadequate. This is necessary to allow restoration of the blood supply and the healing of torn ligaments. The cast is applied in the cock up position with slight radial flexion to include the palm of the hand and the base of the thumb, but does not limit the motion of the fingers. Following the removal of the cast a straight splint can be applied for a few days or a flannel bandage applied and motion started at once. Most of these cases seen within the 48 hours following trauma will do well under this routine. The mistake most people make is to shorten the period of absolute rest.

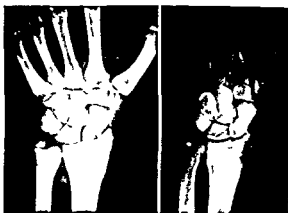


Fig 4 left Same patient February 1933  
Fig 5 Same patient September 2 1933

Cases with marked separation or comminution of fragments should be operated on at once removing part or all of the bone.

The third group of cases now comes up for consideration and they represent the crippling ones that have had months of trial with the resultant pain and weakness so often seen. This group represents the cases treated or otherwise and they are usually untreated or poorly treated that have gone on to mal union, cavity formation, bone formation along the radial styloid to a definite poor result. Men engaged in the heavy occupations requiring the use of the wrist continually are practically totally disabled. Some time ago many of the industrial surgeons were consulted for their opinions regarding the end results of removing part or all of the scaphoid. While some favored total removal and others partial, all agreed that the results were not too good and advised leaving the wrist alone if possible.

Dr. John Adams of Boston, so far as I know, was the first one to resort to the graft operation for these cases. It was thought at first that this produced bony union, but time has proved that the union is fibrous in many cases. However, clinically this operation gives a good result in the few cases tried and should be used more extensively. The remarkable thing about it is that the patients are satisfied and feel entirely relieved from their previous symptoms. In performing this operation I have grafted a piece of the tibia, others make use of the radius on the same arm. Some men believe in the bone peg instead of the graft. The peg operation is much easier, but I think that it does not stabilize the parts so well as the graft. Following the operation, the wrist is put up in plaster as above, i. e., dorsal flexion with slight radial flexion. This is kept on for 6 weeks, to be

months shows what appears to be straight bony union

Results in the cases reported to date are much more satisfactory than those operated on by any other method. They require more time for conservation but the anatomy is undisturbed and the patients themselves feel very much satisfied. They are entirely relieved of their symptoms. Besides, another operation is brought to the attention of those working in this field. I believe that this graft operation is easily performed, does not change the anatomy of the wrist, and does give excellent results.

At first the X-ray films of these cases show what appears to be bony union, but as a rule this bony union changes to one of fibrous union at the end of some months, judging from experience with a few cases. Case 2, however, at the end of 9 months shows a bony union. Clinically the boy is extremely happy over the result.

Case 2, N. V. student, aged 17 years, injured his wrist in December, 1909, and injured it again recently. December, 1933, graft operation was done. Plaster cast was worn 6 weeks. Anterior splint 10 days. This boy also had an united fracture of the styloid of the ulnar. Figure 3 shows wrist before and immediately after operation. Figure 4 shows wrist 2 months later. Figure 5 shows wrist 9 months later. From an X-ray point of view this case appeared to be bony union. Clinically the boy is extremely happy over the result.

It is indeed gratifying to have the subject of fractures of the jaw bones included in this symposium on fractures in general, because there has been a tendency on the part of the surgeon to underestimate their importance or to set them apart as lying exclusively in the field of the specialist.

The surgeon is being confronted with cases of serious injury of the facial bones more and more frequently owing to automobile accidents, and the proper management of such cases demands his earnest consideration. He is often unfamiliar with comparatively simple methods of fixation for fractures of the facial bones, consequently he is likely to pay more attention to repair of the overlying soft tissues, leaving the fractures without early reduction, and thus allowing secondary deformity to result. These facial injuries are frequently associated with shock, concussion, fracture of the skull, or intracranial hemorrhage, and it is quite natural that emphasis on the more urgent complication should at times cause the consideration for the life of the patient should be more or less disregarded. Con-

course be superfluous, but this should not prevent some attention to the facial injury at an early date in most cases. Early reduction and fixation are of the utmost importance here just as in fractures of other bones, since delayed reduction may result in malunion causing interference with function in many cases.

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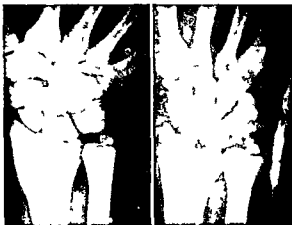


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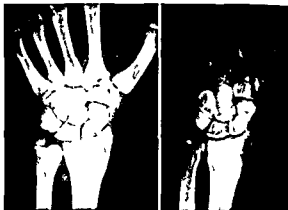


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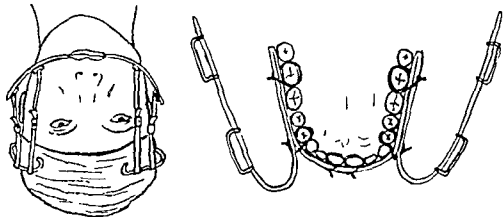


Fig 4 a, left figure, Heavy arch bar secured to teeth with wire ligatures for treatment of fracture of upper jaw, b, attachment of apparatus on upper teeth to plaster head cap, holding upper jaw against base of skull

space for feeding. There are certain complicated types of fracture of the mandible requiring special methods of fixation. For information on these methods special works on the subject should be consulted.

than those of the mandible. They are often associated with extensive head injuries, fracture of the skull, cerebral concussion, etc. There are no powerful muscles attached to the maxilla, consequently displacement of fragments is usually due to the direction of the traumatizing force, although sometimes to gravity. Fractures of the maxilla may be unilateral or bilateral

Unilateral fracture is usually caused by direct force coming from in front or from one side. There is a split in or near the median line of the hard palate and on the labial aspect the fracture line extends horizontally or obliquely backward above the level of the teeth. There are symptoms of confusion of the face and the entire maxillary dental arch on the side of injury is usually depressed. By gentle manipulation, mobility of the fragment can be demonstrated. Many cases can be successfully treated by pushing the fragment back in place until the teeth are in apposition and then wiring the teeth of the sound maxilla to those of the mandible.

*Bilateral fracture of the maxilla is usually caused by direct force from in front or slightly to one side, this type is illustrated by cases in which the passenger's face strikes the steering wheel or a suddenly arrested automobile. In the majority of cases the entire upper jaw is displaced backward and sag's downward posteriorly so that the upper teeth are posterior to the lower and only the last molars occlude, leaving a space between the incisors in front (Fig 3). The entire dental arch can be moved as a unit*

Fixation by means of the mandibular teeth is not advisable at first because of the mobility of the lower jaw. Support here should be obtained from the cranium by means of a head apparatus and reversed Kingsley splint. We have had made an emergency apparatus of this type which can be kept on hand in two or three sizes so as to be immediately applicable. It consists of a heavy metal arch bar to be secured to the outer surfaces of the upper teeth with wire ligatures and provided with arms extending out of the mouth on each side for attachment to a plaster-of-Paris head cap means the upper jaw can be gradually guided into position and after a week or 10 days when the upper and lower teeth have regathered their occlusion they can be fastened together with wire ligatures for a period of 3 or 4 weeks until union is complete. Reduction of this fracture should be begun as early as possible, because if delayed too long union sets in and it may become very difficult to move the displaced bone by gradual traction. Correction of firm malunion in the lower jaw by operative procedures is generally not to be considered.

A brief consideration of fractures of the maxilla and nasal bones is not out of place here. Fracture of the maxilla or zygomatic bone is always due to direct violence, and usually the fracture occurs at or near its junction with other bones, the body of the maxilla being depressed and often impacted.

A depression is seen in the cheek on the same side as the injury, just below the outer corner of the eye, while low down in the cheek appears to be swollen. The entire side of the face may be so swollen and cedematous as to mask the deformity. Diplopia may be present, due to the depression of the floor of the orbit or interference with the action of

ocular muscles Subconjunctival ecchymosis is seen Epistaxis usually occurs, due to rupture of the maxillary sinus mucosa The patient complains of numbness of the side of the nose and lip, owing to infraorbital nerve injury, and often has difficulty in occluding the teeth owing to interference with the coronoid process of the mandible Palpation reveals tenderness and irregularity of outline at 4 points over the zygomatic arch, the junction of the malar with the frontal bone the lower rim of the orbit, and where the malar joins the maxilla below X ray examination made with the skull in the vertical position will outline clearly the depressed malar as compared to the normal side

The depressed bone should be elevated as early as possible as neglect of this will result in a permanent deformity Union in malposition occurs rapidly so reduction should not be delayed beyond 2 weeks Many methods of elevation have been advocated The most efficient in our hands is that suggested by Gillies which consists in lifting up the bone by a long flat elevator inserted through a small skin incision in the temporal region The elevator passes through a slit in the temporal fascia and slides down on the temporal muscle beneath the malar The necessary amount of elevation can be controlled by the fingers placed on the cheek No fixation is necessary The incision is closed with a suture and leaves no visible scar since it is above the hair line

*Fracture of the nasal bones* is also due to direct violence The nasal bones may be thrust directly backward with or without comminution the septum being crushed or buckled beneath them or the bones may be displaced to one side

It is desirable to replace the bones if possible before swelling masks the deformity, that is, within the first few hours after injury If postponed for 2 weeks or longer union may require dislodgment with a chisel Fractures with little or no displacement do not require treatment In recent cases, it generally has been possible to elevate the depressed bones by pushing them up with a closed pair of curved Kelly forceps inserted in the nostril and molding with the fingers externally The use of intranasal splints is not as a rule satisfactory, but the nose may be packed with gauze soaked in liquid petrolatum for 24 or 48 hours to maintain elevation and control hemorrhage

Where the nasal bones tend to sag down a mattress suture of fine wire or silkworm gut passed beneath them through the skin from side to side and tied over lead plates resting on the skin will often aid in preserving the prominence of the bridge Recent cases with lateral deviation also can be corrected by manipulation, and recurrence of the deformity may be prevented by Blair's scheme of engaging the lower end of the nasal bone on the deviated side in a loop of fine wire passed through the skin allowing the ends to pass down across the septum into the vestibule of the mouth on the opposite side and securing them to a molar or premolar tooth

The main objects of this paper have been to urge upon the surgeon the desirability of early replacement of fragments in fractures of the facial bones, and to call his attention to the availability of simple methods of fixation quickly applicable without special dental laboratory technique



ACUTE FRACTURES<sup>1</sup>

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## REDUCTION

Writings on the treatment of fractures coming to us through many centuries have insisted almost universally on the necessity for early reduction. Early reduction, however, must not be practiced at the expense of thoroughness in diagnosis. Any hospital or individual accepting the care of fractures should see to it that the service provides both promptness and thoroughness, responsibility not being delegated to the inexperienced. The actual care of such fractures should be carried out or closely supervised only by those with sufficient training, experience, and, by no means least, interest.

The methods of securing reduction of fractures are legion, although fundamentally there are but three, namely, manipulation, traction, and open operation. The result of any attempt at reduction should be definitely recorded with the roentgenogram, preferably also after the retentive apparatus is on.

There should be no quarrel between the closed and open method. It is much better, if the open method is to be used, to employ it in selected cases at once and not reserve it for use only after the closed method has failed.

Reduction of the fragments to perfect anatomical alignment as a guarantee of restored function is desirable but not always necessary for good function, in fact, insisting on such perfection may in some instances actually do more harm than good. In children it is surprising to see how an early result following reduction and retention of a troublesome fracture of the lower end of the humerus that is anatomically and functionally unsatisfactory in a year or two smooths out another that is anatomically and functionally unsatisfactory in a year or two smooths out another that is a correct weight bearing line will return to the ankle without articular injury and in which of the fragments is relatively slight and the condition can be improved but little even though the joint is opened. With such fractures much depends on the amount of crushing and actual destruction sustained by the underlying support-

ACUTE fractures are generally relatively easy within the first few hours after the accident, before muscle spasm has become more or less fixed. Roentgenographic examination of any fracture is essential, and only in unavoidable circumstances should it be omitted. Compound fractures should be treated as nearly as possible as one would treat a closed fracture, reduction being accomplished at once if practicable. In this paper I shall not consider compound, or open, fractures as a separate entity, but my remarks will be applicable in the main to both types. The open method of treatment should rarely be used for the correction of compound fractures.

## DIAGNOSIS

Although the roentgenogram is pre-eminent as an aid in the diagnosis of fractures, it should not be relied upon to the exclusion of physical examination.

The wounded extremity should be carefully examined for alterations of the skin and contusions, and for injuries to nerves, tendons, muscles, and vessels. It is surprising how often musculoskeletal paralysis is missed at the first examination in fractures of the humerus, all attention being focused on the fracture. Manual examination and manipulation to establish a correct diagnosis is correct in theory, but in actual practice it is seldom necessary, for the roentgenogram gives much more definite information and makes painful manipulation unnecessary. Comparative measurements as to length, particularly in the lower extremity, should not be neglected.

With the aid of the roentgenogram it is possible to determine definitely the site of fracture—whether such fracture is in the shaft or in the region of the epiphysis or joint, likewise can be determined whether the fracture is comminuted, transverse, spiral, or oblique, and whether the fragments are apposed, angulated, or overlapped. In the pioneer days in this country education was restricted largely to the rudiments of anatomy, and Rithmetic. We may without any such poetic license restrict the rudiments of the treatment of fractures to three R's also, namely, Reduction, Retention, and Restoration.



Fig. 1 Comminuted trochanteric fracture before reduction



Fig. 2 Trochanteric fracture reduced and retained by aid of two Kirschner wires

ing spongy bone. Hemorrhage into the capsule with subsequent fibrosis often leads to a tedious convalescence and in such cases the aim should be for early joint motion.

Whether or not the open method is to be used for any fracture will depend to a great extent on the individual surgeon—on his inclination, training, and on the equipment at his command. While satisfactory reduction of a given fracture may be obtained by the closed method, satisfactory external fixation and maintenance of alignment may be difficult to accomplish. If so, the surgeon should not hesitate to use some form of internal fixation and thus avoid the dangers of precarious retention. The fact that external fixation must be used in addition to the internal fixation is no sound argument against the use of internal splinting. While I by no means advise open reduction of fractures as a routine method, I value it highly and have used it often with benefit to my patients and with satisfaction and comfort to myself.

Those fractures which in my opinion are best treated by the open method are fractures of the patella, of the olecranon process, of both bones of the forearm, of both bones of the leg, and of the upper third of the femur. I am inclined to include also trochanteric fractures, fractures of the lower third of the femur with great displacement, certain fractures of the surgical neck of the humerus with marked rotation of the head, and comminut-

ed fractures of the head of the radius. Fractures of the clavicle, wrist, and ankle are best treated by the closed method, as are also most of those of the lower end of the humerus. In many instances a fracture seen late, which might have been satisfactorily treated by the closed method soon after the accident, is better treated by the open method.

There is no valid reason why the open method should not be employed for fractures whenever necessary. So far as I know, there has never been a fair presentation in the literature on the subject which would tend to prove that the open method gives poorer results in comparable cases than the closed method. The best report, that by the British Medical Association Committee, as a matter of fact, tended to indicate that the open method, all things considered, gave even better results than the closed.

#### RETENTION

Retention of the reduced and approximated fragments, often the greatest problem in the treatment of fractures, may be accomplished by internal means alone or in conjunction with some internal means also. After reduction or locking of the fragments together and placing the limb in a neutral position with muscle pull balanced, retention is simpler because the normal muscle pull holds the ends of the bone locked. In a frac-

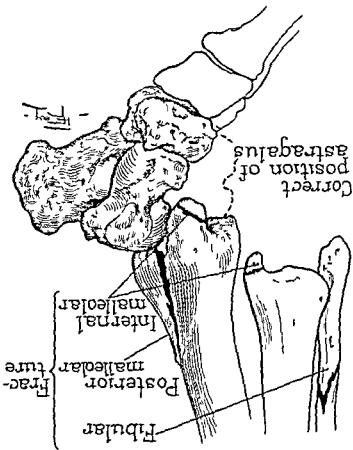


Fig. 3. "Trimalleolar" fracture of ankle

extent in fractures. The roentgenogram affords the best means of determining the amount of callus and its maturity. Discontinuance of the retentive apparatus is permissible only when callus has developed and aged sufficiently to insure development of bony union. Some such protective apparatus as a walking caliper should be used for fractures of the lower extremity in order to aid in bearing the weight, not should this precaution be omitted without the consent of the surgeon in charge.

Truly a worrisome point is to decide the time when the fractured extremity may be used. If use is permitted too early, deformity at the site of fracture may ensue, which, if not promptly corrected, leads to permanent malunion. Exercises local tenderness over the site of fracture means an immature callus, and is a danger signal. Light massage and gentle active movements should be conducted without pain. If the fracture is kept in fixation too long, the muscles tend to lose their tone and elasticity and they undergo fibrosis, the fibrous capsule of the contiguous joints contracts, movements become painful, and convalescence is unnecessarily prolonged. With heavy people Pott's fractures of the ankle should be protected in weight-bearing by slight elevation

of the humerus, for example, particularly of the upper third, muscle balance with the arm abducted (not beyond 45 degrees) tends to hold the fragments together after reduction, as does also the abducted position with internal rotation in a fracture of the neck of the femur. Plaster of paris with suitable padding affords the best material for external fixation, although splints, if used intelligently and skillfully, may be employed. Generally speaking, splints should be retentive and not corrective. Ischemic paralysis due to venous stasis, especially in fractures of the upper extremity, is a dead complication, and it is by no means always due to tight dressings, for I have seen it develop when splints, bandages, or plaster had not been applied. Hemorrhages within muscular fascial planes may produce enough tension to cause ischemia. Prompt recognition of such a happening immediately followed by multiple small incisions to evacuate blood and relieve pressure will prevent the development of ischemia.

Traction, either skeletal or skin, is a great aid in retaining the fragments in alignment, as is best exemplified by the Thomas extension splint. The Thomas splint is a wonderful splint, but we often expect too much of it, for it is by no means automatic reduction and the use of some form of

## RESTORATION

which is the privilege of but few to possess. The length of time that retention is necessary varies in different individuals and to a certain extent in different parts of the body. The length of time that retention is necessary varies in different individuals and to a certain extent in different parts of the body. The length of time that retention is necessary varies in different individuals and to a certain extent in different parts of the body.

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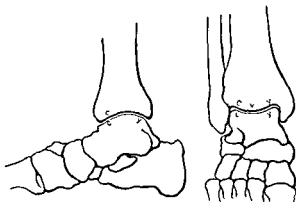


Fig. 4. Relation of concavity to convexity in antero-posterior and lateral views.

of the inner side of the sole and heel, by an inside T strap, and by an outside iron to prevent valgus. Weight bearing should not be permitted in cases of fracture of the neck of the femur until bony trabeculations crossing the line of fracture can clearly be seen in the roentgenogram; this is evidence of union. A fracture of the shaft of the femur, even though it seems clinically to be solid, should always be protected by the use of a walking caliper until bony union is certain.

Massage and heat in some form are of undoubted aid. Active movements are better than passive movements because they promote increased circulation through natural stimulation. Passive manipulations are actually dangerous when left to the inexperienced.

#### TRIMALLEOLAR FRACTURE OF THE ANKLE AND RECENT FRACTURES OF THE NECK OF THE FEMUR AND TROCHANTER

The two fractures of the lower extremity that leave in their wake the most serious disabilities are certain fractures of the ankle and of the hip. I will again call your attention to one type of fracture of the ankle, which was so forcibly brought to our attention a few years ago by Dr. Cotton of Boston that it is known in many places as Cotton's fracture. It is a Pott's fracture with fracture of the posterior margin of the tibial joint surface causing posterior displacement of the foot. I choose to call it 'trimalleolar' fracture of the ankle.

With such a fracture there is a tearing of the internal lateral ligament or fracture of the internal malleolus, fracture of the external malleolus or fibula in the lower  $2\frac{1}{2}$  inches (6.5 cm.), and fracture of the posterior tibial margin or posterior malleolus, hence the term, 'trimalleolar' (Fig. 3). The too common mistake is to correct only

the lateral displacement, leaving the astragalus displaced posteriorly. If the latter condition remains uncorrected it leads to permanent disability of no inconsiderable degree, and it is the one fracture of the ankle that should always be kept in mind. It rarely requires open operation and should be reduced as one would reduce an ordinary fracture of both malleoli, but care should be taken that the foot is brought forward and that the astragalus is replaced in normal position in the mortise between the malleoli. A good antero-posterior film of the ankle joint shows that there is normally a slight concavity in the upper surface of the astragalus and into this should fit the slight convexity on the articulating surface of the lower end of the tibia. Laterally the opposite is true; there is a convexity on the upper surface of the astragalus which fits into a concavity in the lower articulating surface of the tibia (Fig. 4). If these two surfaces are seen to fit when viewed antero-posteriorly and laterally little attention need be paid to slight displacement of the malleoli.

The surgical bugaboo in fractures of the neck of the femur is non union. The old teaching that non union should be expected in fractures of the hip has long since been discarded, largely through the teaching of Whitman and the adoption of his abduction treatment. Taken by and large, the Whitman method has given the best results thus far obtained. It remained, however, for a Boston surgeon to offer a method which necessitates an operative procedure, but not necessarily a formidable one, and in my opinion promises a higher percentage of cures. Smith Petersen, by the use of his flange-nail, has afforded us, I believe, a most valuable method of treating these fractures and one that bids fair to give better results than any other method. I have offered a modification or an aid to his method which I found had also been advocated by Johansson of Gothenburg, Sweden, and King of Australia.

The difficulty in the use of the Smith Petersen nail is in placing it accurately. The modification mentioned, which is shown in Figure 5, briefly is as follows. The hip should be reduced in the ordinary manner, as advocated by Whitman, and antero-posterior and lateral roentgenograms taken to be certain that the position is correct. A Kirschner wire is then introduced through the trochanter, neck, and head, and a slight distance into the acetabular wall. Antero-posterior and lateral roentgenograms are taken to determine that the position of the wire is correct, if the position is not correct the wire can easily be withdrawn and re-inserted. When satisfied that the line of the wire is correct, a special cannulated

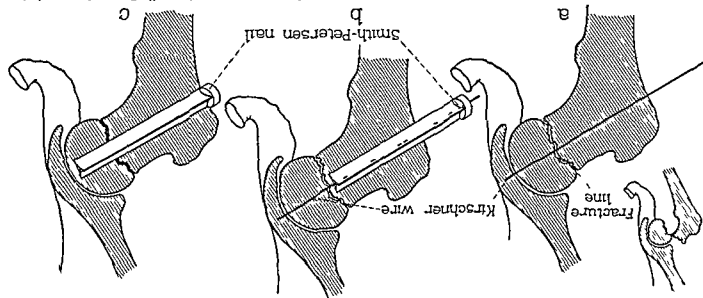


Fig 5 a, Kirschner wire *in situ* through trochanter, neck, and head and into acetabular wall. Insert, fracture before reduction. b, Smith-Petersen nail threaded over wire c, Wire removed leaving Smith-Petersen nail in position

Fractures of the trochanter in my experience unite readily although malposition with shortening is far too common and, contrary to the usual teaching, not easy to prevent. The most satisfactory method we have used is, after reducing the fracture on the fracture table, to place two Kirschner wires at different angles through the trochanter and well into the neck (Fig 1). This will steady the fragments and prevent their slipping while in the cast or extension splint. These fractures are often comminuted and far more extensive than appears in the roentgenogram, (Fig 2), making it difficult to lock the fragments together firmly enough to prevent the strong pelvic thigh muscles from causing angulation. The wires used as pins prevent this and they are readily removed under local anesthesia when the fracture is united.

Smith-Petersen nail is threaded over the wire and driven in. Another anteroposterior film is taken (or the fluoroscope may be used) and discloses whether the nail is safely embedded, although it should not be so far in as to engage the acetabulum. This is the only untoward thing that may happen, because the nail must follow the wire. When it is determined that the nail does not engage the acetabulum the wire is withdrawn (Fig 3), the wound closed, and a plaster-of-Paris cast applied from the middle of the leg up to and including the thorax. The cast is split at the end of a week and movement of the hip begun. At the end of 3 weeks the cast can be removed and the patient allowed to be up on crutches. When roentgenological examination discloses bony union the nail may be withdrawn, usually about 5 months after the operation.

BONE GRAFT FOR NON-UNION OF THE CARPAL SCAPHOID<sup>1</sup>

GORDON MURRAY, M.D., F.R.C.S. (ENG.), TORONTO, CANADA

WHEN a patient complains of a "sprained wrist" with symptoms lasting more than 2 weeks, the possibility of a fracture of the carpal scaphoid should be considered and the necessary investigation undertaken. If examination shows a fair range of movement of the wrist joint in all directions, but limitation at the extremes of all movements, with tenderness in the anatomical snuffbox when the hand is adducted, and over the dorsal and palmar surfaces of the scaphoid, with negative findings elsewhere it is probable that there is a fracture of the scaphoid. If these findings persist for months or years after an injury causing symptoms in the wrist joint, the possibility of non union of a fractured scaphoid should be considered.

X-rays taken of the carpal scaphoid in the anteroposterior and oblique directions usually provide the necessary evidence, but recent fractures may be difficult to see with X-rays taken in various directions. There are cases of recent fracture, easily diagnosed clinically, in which the first roentgenograms do not show the lesion although plates taken a few weeks later will show obvious signs of fracture. Older fractures with non union are seen more easily owing to the early rarefying osteitis and fibrous union, and later sclerosis of the adjacent margins of the fragments.

Fractures of the tuberosity always unite if the fragments are in apposition, and those through the intra articular surfaces about the waist of the bone, which are the most common, may unite if treated. Johnson has shown experimentally that there is an adequate blood supply to the bone as a whole, and to both fragments, in case of fracture. He showed also that the type of reaction in fracture of the scaphoid is similar to that in other bones but is more localized to the fracture line, as there is so little periosteum to assist in the formation of subperiosteal callus. The formation of bone in the callus is slower than in other fractures.

Adams and Leonard say that untreated fractures of the scaphoid always result in non union, and with the usual form of treatment a small percentage shows union. Grace supports this view with a report of cases showing a high percentage of non union in those treated by immobilization for a period varying from 6 to 8 weeks. Boehler, on the other hand, states that most fractures of this bone unite if treated early by prolonged

fixation, and this agrees with our results. However, there are many injured wrists treated as sprains without fixation which provide the cases of fracture with non union.

Certain anomalies should be kept in mind to prevent confusion in making a diagnosis of fracture and non union. Ordinarily the center of ossification appears in the sixth year, but there may be 2 centers and these may not unite but persist to form 2 bones. Rarely the os centrale may persist as a third bone.

Methods of treatment that have been advocated for non union are excision of one or both fragments or of all the bones in the proximal row, including the fragments of the scaphoid. Any one of those operations leaves a deformed wrist with some permanent disability in the form of impaired function and frequently with pain on active use of the hand (Grace).

If the individual with non union of a fractured scaphoid is able to follow a sedentary occupation and avoid energetic use of the hand, he may have little discomfort, but if his life includes heavy labor, sport, or other strenuous vocation where full range of movement of the wrist is important, the best prospects are offered by a bone graft. There is a report of one case in which this operation was used, but the method has not come into general use. In our cases with non union this form of treatment has yielded the best results. It is essential to have X-ray evidence that both fragments are viable and in apposition, and that there is no arthritis.

## OPERATIVE TECHNIQUE

With the hand in full adduction a curved incision is made along the radial surface of the wrist joint extending about  $1\frac{1}{4}$  inches upward and downward from the radial facet of the scaphoid. The ends of the incision are curved toward the posterior surface of the wrist, and the convexity anteriorly should reach the tendon of the abductor pollicis longus. The radial nerve and vessels and the abductor tendons of the thumb are retracted anteriorly, the extensor pollicis longus tendon posteriorly. This provides exposure of the tuberosity of the scaphoid. A small transverse opening is made through the dorsal capsule of the wrist joint, exposing the dorsal surface of the radial facet of the scaphoid, and on this surface the fracture line is apparent. If the other bones

<sup>1</sup>Presented at the symposium on the Treatment of Fractures before the Clinical Congress of the American College of Surgeons, Boston, October 16, 1934.

of the carpus have not been disturbed by the injury the fragments of the scaphoid will not be displaced, and in that case the fracture line is not disturbed by curetting, etc. After cleaning the most prominent area of the tuberosity a small nick is made in the bone at this point with rongeurs, in order to provide for counter-sinking of the graft and prevention of bone proliferation, which might interfere with abduction of the wrist joint.

With about a  $\frac{5}{16}$  bit, a hole is drilled, beginning at a nick in the tuberosity, through the proximal fragment, across the fracture line and into the distal fragment. Great care is necessary to line the drill properly, assisted by observations through the dorsal window, so that no cartilaginous surface is damaged. The depth of the drill hole after the graft is made in the bone at this point with rongeurs, in order to provide for counter-sinking of the graft and prevention of bone proliferation, which might interfere with abduction of the wrist joint.

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The hand is supported in a circular plaster in a cock-up position for 8 weeks. All our cases in the General Hospital had X-ray evidence of bony union after this period, and within a few months the fracture line had disappeared. There was complete restoration of function, with a full range of movement in all directions without pain and with normal grip.

COLLES' FRACTURE<sup>1</sup>

HARRY PLATT, M D, M S, F R C S, MANCHESTER, ENGLAND

THE subject of Colles' fracture, though admittedly well worn, presents many features of interest and importance to the surgeon whose field of practice embraces the treatment of bone and joint injuries. In hospitals where the segregation of fractures is an essential part of the surgical organization it should be possible to guarantee to all patients with a Colles' fracture a wellnigh perfect anatomical and functional result. But a considerable proportion—possibly the majority of Colles' fractures—must inevitably be treated under less ideal conditions. In Great Britain at least (I am unable to speak for the United States of America) this common fracture of the wrist is still traditionally regarded as an injury which may be safely left to the sole jurisdiction of the family practitioner. Statistics obtained from large insurance companies relating to periods of disability following injuries of this type indicate quite clearly that the treatment of Colles' fracture, except in the hands of the expert leaves much to be desired. On the other hand, we must appreciate the fact that, even under the conditions of an organized fracture service, the mechanical difficulties encountered in the treatment of Colles' fracture in all its phases cannot be lightly dismissed. I believe that the quality of the work of any hospital fracture clinic may be judged best by the precision shown in dealing with these fractures.

The successful treatment of this injury calls for three essentials (1) a high degree of manipulative dexterity, (2) accurate and uninterrupted control of the fracture throughout the stage of consolidation and (3) a knowledge of the fundamental principles concerned in the mobilization of an injured joint. Failure in any one particular will mean an indifferent or even a disastrous result.

## ANATOMICAL AND CLINICAL CONSIDERATIONS

It is unnecessary to enter into a detailed discussion of the anatomical and clinical picture of a fracture which is familiar to every practicing surgeon. Certain facts, however, are worthy of emphasis.

1 In the first place *gross displacement* reproducing the characteristic 'dinner fork' deformity of the older textbooks is relatively uncommon. But varying degrees of displacement obvious on inspection in most cases to the practiced eye, or clearly revealed in radiograms, occur in at least 75

per cent of the Colles' fractures seen in ordinary hospital casualty practice. It must be remembered that minor degrees of displacement become masked after some hours by the swelling due to the accumulation of the hæmatoma around the fracture line.

2 In my own experience the classical *triple displacement* of the lower fragment is present in a minority of cases. Either backward displacement *en masse* or radial deviation may be absent. In many Colles' fractures the deformity simply consists of a backward tilt of the lower end of the radius, which, when well marked, reverses the plane of the lower articular surface. In the absence of crepitus this deformity is frequently overlooked, in spite of the loss of the normal concavity of the lower end of the radius, which is so striking a clinical sign.

3 *Communion* is a factor to be reckoned with in many fractures, and the direct involvement of the wrist joint by a secondary line of fracture, combined with spreading of the multiple fragments, adds to the difficulty of the problem of ultimate mobilization.

4 Disturbance of the *inferior radio-ulnar* articulation must also be considered. In not less than 50 per cent of Colles' fractures the fracture line on its mesial aspect reaches the upper limit of the articular facet for the head of the ulna, or enters the joint lower down. I have not been able to satisfy myself that involvement of the radio-ulnar joint in this fashion materially affects the function of rotation of the forearm, provided the injured joint is mobilized with discretion. Much more serious, however, is the disturbance which may result from a fracture of the ulnar styloid process at its base, or the equivalent injury—detachment of the fibrocartilage from the lower end of the ulna. As regards the frequency of this latter complication I have no statistical data, for clinical proof of its existence is rarely forthcoming. This point in the anatomy of Colles' fracture has exercised the minds of surgeons for many generations.

## TREATMENT

*Technique of reduction.* In a recent fracture comparatively little force is required to effect a complete and accurate correction of the displacement of the lower fragment in all three planes. Reduction by manual pressure applied directly to the bony fragments, as taught by the late Sir

<sup>1</sup>Presented in the symposium on the Treatment of Fractures before the Clinical Congress of the American College of Surgeons, Boston, October 16 1934.





radiograms after the second week. If the slightest change is discovered in the position of the lower fragment the plaster should be removed, the fracture remoulded, and a new plaster applied. This is usually possible without anaesthesia. Since the adoption of this routine in my own fracture clinic secondary deformity has become practically unknown.

**Mobilization** On removal of the plaster gutter where the fracture has been immobilized without interruption for not less than 5 weeks, the excellent nutritional condition of the limb is always striking. There is no oedema and all digital joints are supple and painless. The wrist and inferior radio-ulnar joints also allow a short range of movement without discomfort. Although in the majority of cases the patient may now be entrusted to work out his own salvation by active movements, he should not be left entirely to his own devices. The pace of mobilization should be determined by the anatomy of the fracture. Where there has been marked comminution, or involvement of the inferior radio-ulnar articulation or where the wrist is the seat of a pre-existing arthritis, the joints should be allowed to take strain very gradually. Overzealous active mobilization in such circumstances may spoil the ultimate functional result. Forced mobilization in any fracture will be disastrous.

The services of a masseuse except in a supervisory capacity, are redundant in a considerable proportion of Colles' fractures. But in many of the older patients, particularly those with ar-

thritic wrists, a judicious scheme of physical treatment is helpful at this stage.

### RESULTS

Some years ago, when the subject of Colles' fracture had excited renewed interest among British surgeons, I was able to investigate the late results in 111 of the patients treated during the 1925-28 period in my hospital fracture service. The findings are shown in the table.

Result	Fractures without displacement	Fractures with displacement
Excellent (including perfect)	18	74
Good—that is, able to do original work but some slight objective or subjective defect	6	10
Poor		3

In a more recent series of 200 consecutive cases treated under similar circumstances, the average period of total disability has been reduced to 8 weeks. These figures are in no way exceptional. I quote them merely to illustrate the quality of result which is now demanded from an organized hospital fracture service where there is unity of control.

It is the duty of those of us who are responsible for teaching the treatment of fractures in the medical schools to ensure that our students, both undergraduate and postgraduate, will be more competent in the future to handle a common injury like Colles' fracture with some degree of precision. We can do this only if our practice is founded on sound physiological and mechanical principles.

THIS article is written because of the many inquiries regarding the operation for recurrent dislocation of the shoulder which the

author first published in 1923.<sup>1</sup> The operation was worked out on the cadaver in 1926 in the dissecting room of the New York Post-Graduate Hospital. On the cadaver the head of the humerus could not be completely dis-

located, even though all the muscles and capsule were severed. The idea of the operation was obtained from an articulated skeleton in which the humerus was held in place by a metal pin, passed through the head of the humerus and attached to the upper angle of the glenoid fossa.

The operation is justified on the grounds of comparative anatomy. Dr Stockard called attention to the fact that in the dog the head of the biceps runs through the head of the humerus, and he was surprised that surgeons had not discovered this long before.

The following is the technique of the operation which I feel will give the best results.

1 The incision begins just outside the coracoid and passes downward for 3 inches in the line of the fibers of the deltoid.

2 The deltoid fibers are divided by blunt dissection. At this point the circumflex nerve and artery may come into view, crossing the wound.

Care should be taken to avoid injuring them. If the nerve is cut we get paralysis of the anterior part of the deltoid. Although this does not affect the outcome of the operation, it may be objectionable in women.

3 The tendon of the long head of the biceps is located by feeling for the bicipital groove. The transverse humeral ligament, which holds the tendon in the groove, is nicked with a knife and then with scissors. The tendon is exposed up to the shoulder joint. In this step of the operation, cutting of the tendon may be avoided by not closing the blades of the scissors while splitting the capsule.

4 The upper edge of the tendon of the pectoralis major muscle is located in the lower angle of the wound. The tendon of the long head of the biceps is divided  $\frac{1}{2}$  inch above this, after stay sutures of black silk have been placed in the proximal and distal parts. If this is not done, the

Nicola Toufick: Recurrent anterior dislocation of the shoulder. A new operation. J Bone & Joint Surg. 19 9 11 18

distal part will disappear under the tendon of the pectoralis major muscle, thereby prolonging the operation. The elbow is flexed about 45 degrees during this step, and throughout the rest of the operation. The synovial membrane covering the tendon should be removed without fail, so that the tendon becomes fixed in the tunnel in the head of the humerus through which it is passed later.

5 By means of a  $\frac{1}{4}$  inch long gouge, a hole is made through the head of the humerus. This begins in the bicipital groove about 1 inch distal to the lesser tuberosity. The gouge should be so directed that it comes out on the articular head of the humerus in the line of the direction of the tendon, from  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch from the edge of the articular cartilage. If it comes out less than  $\frac{1}{2}$  inch from the edge of the articular cartilage, there is a chance for recurrence of the dislocation, because the tendon will not check the arm in extreme abduction. If fixed in the bicipital groove the tendon will not check the arm until it reaches from 25 to 28 degrees of abduction. This amount of abduction cannot be reached without dislocating the shoulder. The maximum of abduction of a normal shoulder is 90 degrees and, combined with the scapular movement, the abduction of the shoulder reaches a maximum of 120 degrees.

6 The gouge is then withdrawn and the loose bone marrow is removed from its cavity. The gouge is reinserted and a flexible probe is passed through the tunnel from the proximal end, guided by the gouge. The probe is threaded with the black silk which is attached to the proximal part of the divided tendon. The tendon is drawn through the tunnel and united to the distal part by means of the black silk, which was passed through the tendon before it was divided.

7 The arm is abducted to a right angle and the transverse humeral ligament is sutured to that part of the tendon of the long head of the biceps which lies in the bicipital groove. This does two things: (1) It insures enough tendon from the head of the humerus to the glenoid cavity, thus removing any restriction of normal abduction and (2) it holds the tendon from moving up and down in the tunnel, and hastens its fixation in the tunnel.

8 The transverse humeral ligament and the capsule are sewed with continuous No. 1 plain catgut sutures, the split deltoid muscle, with a

Presented at the Symposium on the Treatment of Fractures, before the Clinical Congress of the American College of Surgeons, on October 16, 1934.

*few interrupted sutures* In women the skin is closed with skin clips or a subcuticular suture

9 The shoulder is then put up in a simple Velpeau bandage, reinforced with adhesive plaster, with the arm close to the chest and the elbow flexed to 45 degrees This position is maintained for 2 weeks In epileptics it is wise to keep the shoulder immobilized for at least 6 weeks If the operator chooses, the shoulder may be put up in the abducted position of 90 degrees, in a plaster-of-paris shoulder spica bandage In 27 consecutive cases operated upon by the author the simple Velpeau bandage was used with excellent results

10 The after care may include radiant heat, massage, and active movement, with the arm carried in a sling between treatments In 9 of the 27 cases no physical therapy treatment was used These patients made excellent recoveries with no prolongation of the convalescent period, which ranged from 4 to 12 weeks The 12 week convalescent period is to be ascribed to 3 compensation cases

To date 37 cases have been done by the author, with one recurrence This recurrence was in a young man, who, 5 months after the operation, took a position as a camp counselor and caught a 10-pound medicine ball with his hands over his head He felt something slip in his shoulder I

believe that in this case the tendon slipped in the hole which passed through the head of the humerus The tendon was not firmly fixed in the bone, and according to the operative note the synovial membrane surrounding the tendon was not removed This should be done in every case to insure fixation of the tendon in the head of the humerus

Three cases of recurrence of the dislocation have been reported to the author by various surgeons who have used this operation In 2 of these cases the operator operated again In one case the hole in the head of the humerus was too large, allowing the tendon to move up and down in the tunnel, thereby causing it to fray In the other case the hole was not placed far enough on the articular surface of the humerus to check the head when the arm reached 180 degrees of abduction These recurrences were due, therefore, to faulty technique

#### CONCLUSION

The operation described can be used in all cases of recurrent dislocation of the shoulder, whether the pathology be bony, capsular or muscular It is simple to perform, and leaves practically no restriction of motion The convalescent period is short

# CONFERENCE ON TRAUMATIC SURGERY

## INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FREDERICK A BESTLEY, M.D., F.A.C.S., WAUKESHA, ILLINOIS

I would appear that there is an ever increasing interest in this important subject of medicine and surgery in industry, and we take pride in believing that the educational program of the American College of Surgeons is a basic factor in this attitude. This is consistent with all of the broad educational policies of the College which have guided this organization into such a strong institution of learning, that it is comparable to a better medicine and surgery for the patient. It is clearly established that the executives in the Board on Industrial Medicine and Transmatomic Surgery has recently been enlarged by the Board of Regents, and it is our purpose to arrange for geographical groups through which more in-

The survey work by Dr E W Williamson, upon which they have reported and upon which they will make further contributions, has shown some interesting facts, and it is gratifying to note the desire on the part of industrialists to secure the approval of the College for their medical organizations.

The policy of establishing a minimum standard by which the efficiency of medical organizations can be measured, and approved when an industry can be measured, and approved when the subject

It is recognized that this whole subject of promoting the best interest of the hospital patient is a task which is never lost an opportunity to promote the best interest of the hospital patient. It is recognized that this whole subject of promoting the best interest of the hospital patient is a task which is never lost an opportunity to promote the best interest of the hospital patient.

bodies are most essential in producing contentment. What could be more conducive to health in individuals by and large than the intelligent care of the mass of workers in industry? We pledge our best efforts to this end believing that we are loyally supported by every Fellow of the

College, without whose sanction and aid we could accomplish little.

May I express my appreciation of the efficient work done by our secretary Dr Bowman Crowell, head of the Department of Clinical Research, who makes it possible for this work to go forward

## THE PROGRAM OF THE AMERICAN COLLEGE OF SURGEONS IN INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY<sup>1</sup>

FRANKLIN H. MARTIN, M.D., F.A.C.S., CHICAGO, ILLINOIS

THE Board on Industrial Medicine and Traumatic Surgery had its genesis during the World War. Traditions and theories were ruthlessly cast aside. It was necessary to execute tasks expeditiously and efficiently and with the greatest economy of management money, and man power. It was advantageous to the government to develop every facility that would preserve health. Hence a committee on industrial medicine was organized by the Medical Section of the Council of National Defense. Thus government planning and control demonstrated the economic and life conserving value of a co-operative program such as the American College of Surgeons is putting into effect as a voluntary measure.

In a word, this program demonstrated as never before that the employer and the employee could accomplish most if they worked together harmoniously. The great leaders of industry, of labor, and of insurance composed their differences to the great benefit of all concerned. This war experience was a progenitor of the Board under whose auspices this conference is being held.

In 1922, Dr Daniel Z. Dunott convinced the Association of Railway Executives that railway employees would receive the most efficient care in hospitals approved by the American College of Surgeons. Forthwith, by proclamation to the railroads, this association suggested that the employees of railroads, so far as possible and practicable, should be treated in approved hospitals.

At the organization meeting of the Board on Industrial Medicine and Traumatic Surgery held during the Montreal Clinical Congress in 1926, an important first principle was recognized. The leaders of industry of labor, of the insurance and indemnity companies, and of compensation commissions must harmonize their interests. And it is an outstanding slogan of the College that if we can convince the heads of these groups we will

be assured of the full, unqualified co-operation of assistants and associates.

The chairman of our Board, Dr Frederic A. Besley, accompanied me to Washington on June 13, 1933, and we presented in detail the findings and accomplishments of the Board on Industrial Medicine and Traumatic Surgery to the head of the National Recovery Administration, General Hugh S. Johnson, and left with him an outline of a suggested code. His deputy administrator, W. L. Allen, in charge of the hearings of the National Recovery Administration, read our suggestions, accepted them as a basis for consideration, immediately dictated a suggested code covering our representations, and placed the two documents on file in his office for future reference.

A Minimum Standard for Medical Service in Industry has been perfected, and clinics which specialize in industrial medicine and traumatic surgery are under survey by the College to determine those which are equipped to give proper service. It is a stupendous task, but with the support of the public—the employers and the employees—the economic saving will amount to millions of dollars, many lives will be spared, and thousands of potential cripples will be restored to perfect health. Leaders in industry have shown a deep interest in the basic study by the College of this important and far reaching problem. Obviously this is important for it furnishes the impetus for raising standards. Already 622 industrial establishments in the United States have complied with the minimum standard.

It is extremely important that all preventable health and accident hazards in industry shall be eliminated, but it is likewise essential that diseases and injuries shall be properly diagnosed and treated. First and foremost, this will insure proper care to the ill or injured employee, and it will form the basis upon which diseases and disabilities may be reliably interpreted.

<sup>1</sup>Presented in the Conference on Industrial Medicine and Traumatic Surgery during the Clinical Congress of the American College of Surgeons, Boston, October 15-19, 1934.

The reason which has been established by the College between these various interested factors, and a knowledge of every circumstance which

surrounds the care of the ill and injured in industry, has placed the College in a position to aid in bringing about these beneficial, far-reaching results

## A FOUR YEARS' SURVEY OF MEDICINE AND SURGERY IN INDUSTRY

M N NEWQUIST, M D, Chicago, Illinois

thud, the treatment of the ill and injured in industry by competent hands

Inadequate medical supervision leads to inadequate medical service and it is largely for this reason that the College could grant approval to only 55 per cent of the medical services surveyed. During the past summer the College found in one industrial community alone over 90,000 employees who had been given so called pre employment physical examinations by laymen. During the World War 7,000,000 men under 40 years of age were examined physically by medical examiners and 2,500,000 were found to be physically unfit for military service. The strenuous nature of military service naturally predetermined the rigid physical requirements which lead to the high percentage of rejections. In industry, however, opportunity is presented whereby many of those afflicted with physical defects may be safely allocated to jobs that will make them self-supporting. In giving physical examinations to the army in industry, a trained medical examiner is the only one who is qualified to determine physical fitness for work. The solution of the problem connected with this situation is self-evident

The records of pre employment and periodic physical examinations of employees should be considered privileged communications, subject of course to due process of law, and as such they should be kept under medical responsibility and supervision. Only through the efforts of the unbiased physician or surgeon, who guards the health and welfare of the employer, can these examinations and records be of mutual and of greatest value. Adoption of this principle will do much to reduce the opposition on the part of employers toward such examinations

Surveys by the College have further revealed that in some industrial establishments nurses and first aid men are engaged in surgical procedures, such as the suturing of lacerations. This practice on the part of industry is not only unsafe for the injured employee but it is illegal. The requirement

DURING the past 4 years the medical de-

partments or services of 1,122 industrial establishments have been personally surveyed by the American College of Surgeons. Of this number the medical services of 622 establishments, or 55 per cent of the total, have complied with the minimum standard for medical service in industry as formulated by the College and have been granted approval. I am pleased to report that in conducting these surveys, the College has received splendid co-operation from industry.

The campaign of the College to elevate the standards for medical service in industry is not only the practical application of its minimum standard for such service but it also represents a continuous study of the merits and defects of the various industrial medical services now in operation, in order that the data so compiled may be of use in the proper constructive and remedial measures. The good features of the various medical services studied warrant recognition but they will take care of themselves. Let us first consider some of the defects which have been elicited by these surveys

*Defects in medical service in industry.* The major defect observed was that of inadequate medical or surgical supervision of health measures for employees and of sanitation of the plants. The provision of adequate medical and surgical service in industry today requires more than the skillful repair of industrial injuries. This is an age of prevention and the best way to deal with occupational diseases and industrial injuries is to prevent them. Adequate supervision is absolutely necessary in order to secure adequate preventive health measures. Moreover, physicians and surgeons should be authorized to direct medical and surgical policies and procedures in the industrial establishments served by them. Adequate medical supervision will insure, first, adequate first aid and hospital facilities, second, the elimination or reduction of accident and health hazards, and

ment by all states of a license for the privilege to practice surgery should automatically prohibit such practices by laymen

The free examination of eyes of workers in industrial plants for the purpose of selling glasses has been observed to be a common practice carried on by commercial optical companies and by optometrists with the consent of the employers. The underlying commercial motivation of such service overshadows the benefits that might be expected therefrom. The College, through its minimum standard, has definitely gone on record as opposing the examination of eyes by any other than a qualified medical practitioner.

Finally, it has been observed that on account of inadequate medical supervision a number of industrial organizations have failed to institute recognized preventive health measures. In many instances this failure is due to the fact that the plant physician or surgeon has not been endowed by the official management with the appropriate authority to enable him to exercise properly his prerogatives. Of 925 plants recently surveyed by the College, only 7 per cent of the smaller plants had medical supervision of sanitation and general health measures as compared to 49 per cent of the plants having over 1 000 employees.

*Rank of the medical departments in industry.* The medical department should be an independent department co-operating with other departments within the organization but responsible only to a major official. In 925 industrial establishments included in our surveys the plant physician was responsible to the personnel director in 41 per cent of the plants to a major executive in 29 per cent to the plant manager or superintendent in 17 per cent, and to the insurance carrier in 13 per cent. Most of the smaller industrial establishments have delegated the responsibility for the provision of medical service to the insurance carrier. Since our surveys to date have included comparatively few of the smaller plants, the percentage stated above relative to the insurance carrier should in reality be considerably higher.

*Accident statistics.* The National Safety Council has reported the following accident statistics for the United States for the year 1933:

Accidental deaths	90 000
Non fatal disabling injuries	8 730 000
Occupational fatalities	14 500
Non fatal disabling occupational injuries	1 255 000
Automobile fatalities	31 000
Non fatal automobile injuries	1 085 000

That organization has further reported that the frequency rate of industrial injuries declined 58.8

per cent from 1926 to 1933 and the severity rate 39.4 per cent. Proper credit should be given to the role played by good medical and surgical service in this reduction. Investigation has revealed that an efficient medical and surgical service can be responsible for at least one third of the reduction in the injury rates, while the safety service can be responsible for approximately two-thirds.

Studies made by the College have further shown that it is cheaper to pay for good medical service than to pay for disabilities. In a recent analysis of 334 industrial establishments, it was found that the smaller companies whose medical services were considered to be generally inadequate, had 39 per cent greater compensation costs than the larger companies where adequate medical service had generally been provided.

*Workmen's compensation laws.* All states have workmen's compensation laws with the exception of Arkansas, Mississippi, South Carolina, and Florida. During the past 4 years there has been a fortunate legislative trend toward the liberalization of the medical benefits for injured workmen. Several states have increased the medical benefits as to periods and amounts by amendments to their laws, while in some states the industrial commissions have arbitrarily liberalized the surgical fee schedule.

Eighteen states have state fund compensation insurance systems—Oklahoma having established such a fund in 1933. Twelve states have compensation laws covering occupational diseases either by a schedule of diseases or by blanket coverage. It is highly probable that many more states will make provisions for occupational disease coverage in their compensation laws within the near future.

## CONCLUSIONS

In this presentation we have stressed the importance of the administrative or supervisory phase which is necessary in the provision of any industrial medical and surgical service. Industry is not handicapped by a lack of skilled physicians and surgeons in the country. Unfortunately, however, industry does not always provide the skilled medical and surgical service that is or could be made available. For this reason we urge those who are qualified in the field of industrial medicine and traumatic surgery to "chart the course" for industry so that the ethical standards and efficiency of its medical and surgical service may be such as to warrant the respect and co-operation of industry, of labor, and the medical profession.



# THE VALUE OF AN ORGANIZED MEDICAL SERVICE IN AN INDUSTRIAL ESTABLISHMENT<sup>1</sup>

H. L. FERGUSON, NEWPORT NEWS, VIRGINIA  
President Newport News Shipbuilding and Dry Dock Company

THE acceptance of the invitation to address the Conference on Industrial Medicine and Traumatic Surgery on "The Value of an Organized Medical Service in an Industrial Establishment" was prompted by the author's years of experience in the shipbuilding and ship repairing industry. This industry makes use of practically all the trades common to heavy construction work, in addition to many peculiar to its own field. It employs the common laborer as well as the highly skilled mechanic. The opportunity to reduce its mechanical processes to a safe and standard routine is limited on account of frequent situations presenting new and unusual problems. The physical demands on the worker are heavy, and the work generally is above the average in its hazards. It is doubtful if there is any other industry in which an organized medical service is more needed and its value more apparent.

In these days of high labor costs, management is impressed with the importance of the selection of the physically fit to insure productive capacity of a high order and of the reduction of all forms of waste to a minimum, including the waste due to illness and injury of workers. Without a capable medical service, the management of a company cannot succeed in its attempt to establish and maintain these policies. Organized medical departments are the outgrowth of a long and real need for better service to the sick and injured in industry. Surveys of various medical departments have revealed the fact that compliance with the compensation law does not in itself signify an efficient medical service and further that financial awards cannot offset a disability that is chargeable to an inadequate medical service. As a result of these findings the American College of Surgeons has created what is termed a Minimum Standard for Industrial Medicine, which standard embodies the essential features for providing an adequate medical and surgical service. Compliance therewith will serve the best interests of the employer and the employee to learn, by examination, the physical and mental fitness of new employees, to know work requirements and hazards in order to facilitate proper placement of workers, to maintain and improve

the health and efficiency of those already employed, to educate the worker in accident prevention and personal hygiene, and to reduce lost time and absenteeism due to illness or injury. No medical examiner should be considered competent to render a physical examination with recommendations for placement in an industrial establishment until he has a working knowledge of plant activities, job requirements, and hazards. The task of examining new employees and deciding their physical fitness and their place in our company rests upon a graduate physician who has performed this work during the past 6 years. These pre-employment physical examinations, when made by a competent physician, carry with them a safety element in that applicants are rejected who, if employed, would be a menace to themselves, to fellow employees, or to property. They are a direct benefit to the applicant in that they call attention to any remediable defect and further assist in placing the employee in the position for which he is best fitted.

The maintenance and improvement of the health and efficiency of those already employed is an objective that in its practical application works a great benefit to both employer and employee. The periodical health audit is the one most powerful factor that can be put into operation to attain this objective. There can be no controversy over the statement that in practically all instances the efficiency of a workman, all other circumstances being equal, increases with his sense of well being. In connection with the attainment of this objective we believe that it is not only necessary to have capable physicians, but quite as important to have a capable nursing staff. Graduate female nurses are generally used in the clinics of the larger industrial organizations. By virtue of their training, they are familiar with the principles of asepsis and antiseptics, they have knowledge of bandaging, they are already well trained in keeping records, they keep the clinic in a splendid state of cleanliness, and, finally, the white uniform has its psychological effect. These nurses command the respect of the employees, the kind, quiet manner in which they handle the sick and injured explains why there is no difficulty in our plant in having employees report to the medical department.

<sup>1</sup>Presented in the Conference on Industrial Medicine and Traumatic Surgery during the Annual Congress of the American College of Surgeons, October 25 to 30, 1924.

The education of the employee in accident prevention and personal hygiene is accomplished only by persistent effort. Coincident with the pre-employment physical examination our new employee is given a pamphlet, and he is directed to read it. This pamphlet includes many safety measures which, in most instances, cause the reader to begin to think along safety lines. We employ a full time safety engineer and an assistant safety engineer, who work in close co-operation with the medical department and the industrial departments. Careful observation over a period of years is convincing us that 90 per cent of all accidents are caused by carelessness either on the part of the injured man or on the part of some other individual. Continuous efforts are directed toward making the plant a safe place in which to work. A spirit of competition has been built up between the various departments in an effort to reduce both the number and the severity of accidents. Records of the number of accidents per million hour working period and the degree of severity of accidents show conclusively that efforts made to teach men how to accomplish their work in a safe manner, and efforts directed to make materials and machinery safe for men to work with, do bring about results. There is no end to a safety campaign. The personnel of industry is ever changing, the new man does not know so much about the dangers, and the old man has heard so much about them he is likely to become careless.

The reduction of lost time and absenteeism due to illness and injury is the most striking result from the activities of the well organized medical department. The frequency and severity rates are a fair index to the efficiency of the medical service. In many cases the safety of an injured man lies in the hands of the one rendering first aid. The duration of the period of convalescence frequently is in inverse proportion to the degree of thoroughness and correctness with which the injury is first treated.

It has been estimated that the prevention of infection alone would reduce the time lost from all ordinary causes by at least one third. It is obvious that the larger companies owe much of their excellent accomplishment to the fact that their organized medical services have kept the minor injuries from becoming major ones. This is accomplished in our plant by insisting that the employee report to the medical department with any injury no matter how trivial it may seem to him.

Accidents are not the only source of loss which involve medical service. It has been generally accepted that illness causes eight times as much absenteeism as accidents. The protection of the

employee against smallpox by vaccination, the administration of typhoid prophylaxis, are measures which by their institution promptly reduce the number of lost hours.

We believe the lost hours from injury and illness can be greatly reduced by real co-operation between the various departments in any plant. We have brought to a practical minimum the number of disgruntled patients by encouraging them to get back into the old stride as soon as possible, frequently giving them the simplest kind of work at the start.

Surveys show that many of the larger industrial organizations provide excellent medical service for their employees, but that much can be done to improve the service especially in the smaller industrial establishments. This comparative inadequacy is due as a rule not to a lack of skilled physicians or surgeons in the community but rather to a failure on the part of the smaller companies to provide early medical supervision and service and to select only competent physicians. The practical solution of this problem is the definite organization of a plan for medical service which will locate responsibility in competent medical hands. The most important step is the choice of a competent chief surgeon. Managements must choose men of ability, of high ethical standards and if possible, men with better than average personality. After this choice has been made the operation and choice of the remaining personnel of the department may be left entirely to the chief surgeon and the department will reach its greatest efficiency.

The personnel of our medical department is as follows: chief surgeon, assistant chief surgeon, 1 consulting eye, ear, nose and throat specialist, 1 consulting dentist, 3 graduate nurses, 1 secretary, 2 colored orderlies.

The equipment of our clinic consists generally of the following: operating room, X-ray room including a shock proof X-ray with all fluoroscopic attachments, developing room and fire-proof storage space for filing films, dressing room completely equipped, physiotherapy department, 2 ambulances.

The records of the medical department are of invaluable assistance in placing and transferring employees and in determining when they should be retired from active service.

A well organized medical department in the plant performs a service over and above the saving of expense for it prevents the injured employee from getting into the hands of unscrupulous or incompetent lawyers and doctors, enabling the employee to retain all of his compensation, and

## COME OVER INTO MACDONIA AND HELP US!

G. I. MARSTON, BOSTON, MASSACHUSETTS  
 Vice President and General Claim Manager American Mutual Liability Insurance Company

We have found after an experience of many years that it pays to have a properly organized and equipped medical department as an integral part of our organization. In fact, when operating under normal conditions with from 5,000 to 6,000 men, we believe that it more than pays for itself in reducing accidents, illness, and lost time. In my judgment, it also results in the promotion of good will and a mutual protective interest between employer and employee.

During the first years of our experience under

the women's compensation laws, we found accumulating on our books a surprisingly large number of cases classified as permanent totals. A study of these cases revealed all too many of them as falling within the class of what you would call poor end-results. What was the cause? What was the trouble? It is the speaker's personal opinion that this situation was due in large measure to the fact that it was almost impossible to interest the better grade of surgeon in industrial work. In considering this matter we must in fairness to all concerned bear in mind that in those days we were all dealing with a new problem and too much blame cannot be attached to anyone for the mistakes that were made.

A great deal has been accomplished but there is yet much room for improvement. The American College of Surgeons undoubtedly met with a considerable opposition from members of the medical profession when they set out by education to improve the standards of fracture service. Undoubtedly, there was resistance also to the program of the College in respect to the standardization of hospitals, but notwithstanding that opposition, such hospitals anxiously await the announcement from your College indicating whether or not they are upon the approved list. Is it beyond the realm of possibility that the College establish also suitable standards of qualifications which those who would practice in the field of industrial surgery must meet? Is it not possible that the College may even designate those upon whom they will set the seal of their approval as qualified to handle industrial injuries and act as

Presented in the Conference on Industrial Medicine and Traumatic Surgery during the Clinical Congress of the American College of Surgeons October 15 to 19 1934

makes him better satisfied with his work and interested in getting the injured man back on the minimum, as such a department is keenly the plant is able to hold such an expense down to insurance rates. A proper medical department in increasing tremendously, resulting in higher medical expenses for an injured employee as The reports of insurance companies show that the medical expense for an injured employee is

MY title is a sudden inspiration, possibly reflecting a phase of a subject in which I have been vitally interested for many years. I could perhaps as well have captioned my talk, "Why are we not getting better end-results in our industrial injuries?" I presume that a title of any address is more or less necessary if for no other reason than that it keeps one's listeners busy trying to connect the subject as announced with the discourse as delivered. I hope, however, that my few remarks will be less of a discourse and more of a heart-to-heart talk on a subject in which we are all greatly interested.

It may be wise for me to state that I appear before you not only as a representative of my company but perhaps as an ambassador of good will without portfolio and representing the casualty insurance business as a whole. However that may be, time did not permit my securing authority from my associates of our Claims Executive Committee to speak officially for them, yet I feel certain that nothing I shall say would not be heartily accepted by them.

For a little more than a decade we have been struggling to improve the administration and procedure of the most ambitious piece of social legislation ever enacted, a system of compensating the workers in industry who might be injured without regard to the question of fault. The statutes relative thereto are known as workmen's compensation laws. Among the many provisions of these laws are the sections relating to medical care and the expense incident thereto. These medical provisions have many angles and the time allotted me will permit of only briefly alluding to one or two of these angles.

advisors? Your Board of Industrial Medicine and Traumatic Surgery, under the able leadership of Dr. Besley has established a minimum standard of medical service in industry which we heartily approve.

You have probably noted in your programs or in the public press an announcement by Dr. Besley giving a skeleton outline of a program which has resulted from a conference held in New York between representatives of your College, headed by Dr. Martin Dr. Besley, and Dr. Newquist, and the Claims Executives' Committee of the National Council on Compensation Insurance, together with their medical directors. If carried out, this program will mean a higher standard of surgery in the treatment of industrial injuries than we have ever known before. It will mean an earlier return to work of the injured man and a reduction of lost time and wages. The consequent reduction in compensation losses will lessen what is becoming almost an intolerable burden to industry—the amount of premiums paid, which after all reflects the losses. This, I believe, is going to mean much not only to the injured man but to all the groups interested in the administration of the workmen's compensation law, the members of the medical profession as represented by your membership here, the industrial accident boards and commissions, as well as labor.

I wonder if you men have any idea of the tremendous sums that are expended every year for medical and hospital service. According to the report prepared by the National Council on Compensation Insurance dated March 10, 1933, "the compensation carriers represented in the National Council pay approximately forty million dollars annually for medical and hospital service, of which approximately six million goes to hospitals and thirty four million is paid to doctors." A study of the medical cost trend from 1920 to 1929 shows an increase in the average cost per compensable case from \$77.00 to \$102.00, these figures being based on the experience of all carriers in all states over that period. These figures would be nothing to weep over if there had been a corresponding reduction in the compensation losses.

In a report of a special Committee of Claims Executives of the National Council who had given careful study to the question of the constantly increasing medical and hospital costs, it was found that much of the difficulty was due to the "treatment by unqualified physicians and surgeons, ending in poor surgical results, with prolonged disability and extended medical treatment, over

treatment, including physiotherapy, padded bills, additional cost and inconvenience in transferring cases to specialists" and it was their opinion that the principal cure for this situation could be summarized briefly in the word "education"—education, first, of the injured, second, of physicians and surgeons and hospitals, and third of industrial accident boards and commissions.

The importance of the physician in the whole scheme of compensation has perhaps never been fully appreciated. Not only does the physician receive directly approximately one third of all compensation costs, many millions in amount as we have just indicated, but he is also largely responsible for the size of the other two-thirds. The rates of compensation, the schedules and benefits are fixed by law. Industrial accident boards and commissions can only apply the mathematics to the facts as they find them. It is the doctor who in the last analysis determines what the loss is both to the employee and to the employer. His skill determines the period of recovery and the extent of the recovery—in other words, the end result.

His conscientiousness and fairness determine the liability of the employer and the insurer. He is the great variable factor in this whole scheme, and in this connection I come to the last thought that I want to leave with you and that is a situation which should have the serious consideration, not only of this body, but of all state and county medical associations. I refer to the giving of evidence at hearings before industrial accident boards and commissions by men upon whom has been conferred the degree of doctor of medicine and who have been licensed by the state to practice as such—evidence which is neither scientifically reasonable nor scientifically probable. Such men are not only trailing in the dust the fair name of their profession but are dishonestly influencing awards by their false testimony.

May there be a better understanding between the members of your profession and the representatives of the casualty insurance business. Too frequently local groups on one side of the fence or the other (there should be no fence) antagonize each other by statements which do not reflect the real situation. The business of insurance has never been unfriendly to the medical profession.

It is the hope of the business of insurance that the vision which appeared to the Apostle Paul may appear to the Fellows of this great College and they may hear the words and answer the call, "Come over into Macedonia and help us."

# PAPILLOMA AND CARCINOMA OF THE BLADDER AMONG DYE WORKERS<sup>1</sup>

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 Medical Director, E. J. du Pont de Nemours & Company, Inc.

THE so called aniline tumor of the bladder is an entirely new occupational disease in this country, the first cases appeared in 1931, and the first report on a group of cases was made by Ferguson, Washburn, Anderson, Gay and myself. Since this first report (1) further studies by this same group, with the very able assistance of Dr. E. E. Evans and Dr. Humphrey D. Wolfe, have materially increased the data on cases under observation and treatment.

Before presenting this later group, I will very briefly review a few of the earlier investigations and attempt to give you a short description of the general nature of the dye manufacturing industry. In 1895, Rehn reported the first observations made on a group of 45 men engaged in the dye industry in Germany. At that time he reported 2 cases of papilloma and 1 of carcinoma, and suggested the possibility of occupational origin. In 1904 he reported 20 additional cases.

Leuenberger in 1912 reported 18 cases which he had observed at Basel, and at the same time he reported, as a result of studying the statistics of the Basel Clinic, that 50 per cent of all bladder tumors treated at the clinic were among dye workers. Further, he proved that the incidence of bladder tumors was 33 times greater among dye workers than among those outside the industry. Rehn's original theory brought about a great deal of discussion, much dissension, and lengthy investigation. However, his original opinion eventually became an undisputed fact. Bladder tumors were accepted as an occupational disease and made compensable in Germany.

Prior to 1914, practically the entire dye manufacturing industry was confined to Germany and Switzerland. Subsequent to 1914 the industry was developed in this country and has since grown to major proportions.

Basically, the manufacturing process may be divided into 3 stages, viz., chemical, intermediate, and dye. The first stage is a distillation process, and from the coal tar there is derived benzol, toluol, xylol and naphthalene. In the second, or intermediate stage, the products of the first stage are subjected to the processes of nitration, chlorination, reduction, and sulfonation. In the third and final stage, the dyes are compounded. It is in the second, or intermediate stage, that bladder tumors develop and in no instance have they occurred in the first or third stages.

Since 1931, we have made 1,601 cystoscopic examinations, and of this number there have been 1,173 individuals examined, 428 of the examinations have been rechecks. This entire group has been engaged in the manufacture of dye intermediates.

In this group we have found a total of 49 tumors, 35 of which are papillomata and 14 carcinomata. Thus, we have an incidence of bladder tumor in 4 per cent of the group examined. Deaths from cancer of the bladder as recorded in the United States Registration Area from 1925 to 1929 were 3.20 per cent (2). We have no figures indicating the incidence of bladder tumors in 1,173 individuals outside of the dye industries who have had routine cystoscopic examinations.

## ETIOLOGY

The tumor-producing chemicals are encountered in the intermediate stage of manufacture. A careful analysis of our group indicates that beta naphthylamine, benzidine and alpha naphthylamine are the causative materials. In Germany, beta naphthylamine, benzidine, and aniline are accepted as the principal irritants. We have repeatedly examined a group exposed to aniline only, for as long as 18 years, finding no tumor incidence, and therefore it seems possible that aniline is at least a questionable factor. English dye manufacturers have reported several cases from alpha naphthylamine and we can confirm this observation with a group of 12. The final observations have not been made and eventually other chemicals may be added to the list, but we can say that up to the present time beta naphthylamine, benzidine, alpha naphthylamine and possibly aniline are the causative agents.

Length of exposure varies from 5 to 23 years, have reported 1 case in as short a time as 2 years. This case, however, is questionable, since there is no evidence to indicate that this man had a normal bladder when engaged for work. Age does not seem to bear any direct relationship to incidence. In our group the age range was 1 case 24 years of age, 9 from 30 to 40, 13 from 40 to 50 and 12 from 50 to 60.

Presented at the Conference on Industrial Medicine and Transcendental Surgery during the American College of Surgeons, Boston, October 19, 1934.

Family history of cancer seems to be no factor, for we were able to obtain a positive history in only 5 of our cases.

Absorption takes place by 3 routes—the respiratory, gastro-intestinal and skin. The most important route is undoubtedly the respiratory but it must be remembered that skin absorption of intermediates can, under conditions of careless handling, become the most important portal of entry. Further, in view of the fact that tumor production is due to long continued exposure to low concentrations even the gastro-intestinal tract may assume important proportions. One of the most important facts to remember is that after a minimum exposure of 2 years, removal from occupation does not change the possibility of tumor development. Tumors have developed from 5 to 35 years after change of occupation.

#### PATHOLOGY

The pathological anatomy is essentially the same as in tumors of unknown origin. Tumors may occur as primary papillomata or may be malignant from the beginning. They may be single, multiple papillary, sessile, infiltrating or non-infiltrating. The majority occur in or near the trigone but may occur anywhere in the bladder wall. Metastasis is rare and in our group has not been observed.

#### SYMPTOMS

There are no reliable symptoms, either objective or subjective, to be ascertained without actually viewing the tumor through the cystoscope. Hematuria is a late symptom and often does not appear until malignancy is well advanced. Simple tumors may or may not show microscopical or macroscopical blood in the urine. Our routine requires a cystoscopic examination—of intermediate employes once a year while employed every 3 months in those cases which have been positive for tumor, and prior to employment in all cases. German observers rely upon the presence of blood in the urine on 3 successive occasions to determine the necessity for cystoscopic examination. Our experience has convinced us that with this method many early cases progress into the advanced stages before detection. Many papillomata become carcinomata, and carcinomata may reach the stage where complete resection of the bladder is necessary with transplantation of the ureters.

#### TREATMENT

Treatment is divided into two divisions—preventive, and treatment of the tumors.

*Preventive.* The manufacture of dye intermediates must be conducted in such a manner as to

absolutely exclude dust, fumes and skin contact. This means the adoption of an entirely closed process for the manufacture of alpha and beta naphthylamine, benzidine, and aniline.

All applicants for employment in or about these processes must have a cystoscopic examination and before acceptance must present a normal genito-urinary system.

*Treatment of tumors.* Tumors classified as Grade I, which are small and easily accessible, are treated by bipolar fulguration through the cystoscope. Large tumors of the Grade I type are treated by open operation.

Tumors of the Grade II type, which are reasonably small and easily accessible, are treated through the cystoscope by fulguration. Large and inaccessible tumors are treated by open operation.

All tumors of Grade III or IV are treated by open operation and implantation of radon seeds.

Our experience has convinced us that large tumors which are apparently benign may, upon biopsy, show sections which are definitely malignant. Furthermore, every tumor of the bladder can be considered malignant until proved otherwise by biopsy and microscopic examination.

The treatment as outlined is that which we have followed in the past 3 years. We have had only 2 fatalities, 1 case developing an acute retention 3 months subsequent to operation and the other developing a rectovesical fistula, the remaining patients are all back at work with the exception of one who was operated upon about 3 weeks ago.

#### SUMMARY

1. Bladder tumor is an occupational disease occurring among dye manufacturing workmen who are exposed to certain intermediates.
2. Time of exposure and not age is the causative factor.
3. Cystoscopic examination is the only sure method of diagnosis.
4. An absolutely closed method of manufacture will prevent tumor formation.
5. All tumors should be detected as early as possible and destroyed immediately.

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BACK INJURIES<sup>1</sup>

FREDERIC JAY COTTON, M.D., F.A.C.S., BOSTON, MASSACHUSETTS

Treatment is under question only as to whether we should attempt forcible correction of the compressed vertebra or not. With or without this treatment, we must attain hyppertension and hold it. Bed treatment for a month followed by a brace and the indicated exercises usually results in a cure in 6 to 9 months. These patients do almost uniformly well if they are so treated.

Fractures of transverse processes, often multiple, seem to be usually the result of convulsive muscle action and are in themselves unimportant. Union often by fibrous union only, they seem to be only a complication and a visible evidence of a badly wrenched back.

Rupture of cartilages, now talked of, does occur. How important it is, is doubtful, but for the next year or two this lesion with the migration of the much adversed nucleus pulposus will possibly make much legal trouble. How important it is clinically is *sub judice*.

There is no doubt that lumbosacral lesions are overlooked. Congenital lesions, whether full-blown spondylolisthesis or pedicle defect only, may give no trouble for youth and early manhood, but may make a trouble after trauma. These difficulties, and few others, call for spinal fusion. The difficulty is to make a diagnosis and that depends on excellent X-rays. In absence of this definite diagnosis indiscriminate fusion operations are not called for, whereas they have frequently done much harm.

Similarly, fusion operations higher up can be justified only by very definite local signs indicating ligament tear or damage to articulations or the like which are seldom definitely shown. Lately we have heard more than a bit about asymmetry of articular faces and the resulting strain. Most of the back cases seem to be strains of muscle or ligament, tending to hang along, lame for months. If treated with absolute bed rest in cases there is irritative spasm, and with brace support for a few weeks, then with careful exercise following this, most of them will get well. In some cases there is a toxic background calling for the search for foci of infection.

Commonly enough there is an actual pathological arthritis of infectious type. Frequently there is an obvious overgrowth—"hypertrophic arthritis"—which is in fact hardly more than the badge of age or hard work. While the latter condition does not always determine a bad prognosis it does

Back strain is a subject one hesitates to speak on, so cumbered is it with difficulties in diagnosis, with wild theories of pathology and with diverse methods of therapeutic procedure. The fact is that, save for certain specific lesions, we know very little about backs—hardly enough even to draw the line between pathological conditions and those due to actual trauma or continued slight overstrain. We can name certain definite pathological cases, such as the Stumpell-Barre type with ankylosed vertebral bodies, and the infectious type with progressive fusion of sacro-iliac articulations, in which trauma is an exciting and not a producing cause. Similarly, spondylolisthesis or pedicle defects indicate no recent cause although they may be a source of aggravation.

In definite traumatic cases there is no question about the fractures, whether they be of the important transverse process or of the vertebral bodies, for they are of recent origin. However, the differentiation between an old compression fracture and the "occupational" wedge-shaped body (Lane) or changes sometimes seen in elderly patients with hypertrophic changes, is a source of argument.

The occurrence of lumbosacral lesions without pedicle defect or spondylolisthesis is debatable, as are also many sacro-iliac cases. It must be confessed that our diagnosis between lumbosacral and sacro-iliac lesions is clinically far from being precise.

There are sacro-iliac cases obviously involving displacement, usually in flexion, that are not shown in the X-ray, but in which brilliant results from manipulation leave no diagnostic doubt. In all other lumbosacral and sacro-iliac cases, unless secondary changes such as porosis or cartilage absorption are evident, we have no proofs—and as a result we are often wrong in our diagnosis. There are elaborately worked out tests for differentiation but they do not seem to work out very well. Perhaps, to clear the decks, we should consider the lesions as to which we have actual data.

First let us consider fractures, and that means compression fractures from the tenth dorsal to the second lumbar vertebrae. These fractures show clinical localization of symptoms even if there is no obvious deformity. The skagraphy is—

in fresh cases—unmistakable.

Presented to the Conference on Industrial Medicine and Traumatic Surgery during the Clinical Congress of the American College of Surgeons, Boston, October 19, 1934.

give a poorer, slower, comeback after trauma

Very rarely there are sacro-iliac joints that crunch in and out of place. These are the cases, perhaps the only ones, calling for fusion. There are others in which careful history taking and examination leave no doubt of a displacement, usually in a position of flexion. These are the cases for reduction by extension manipulation. When treated, they do as well for us as for the osteopath, and furnish spectacular cures. They cannot be diagnosed by X ray.

As to other sacro-iliac conditions the picture is very confusing. Cases showing the so called clinical signs evidence no displacement, and if there is a pathological condition present it is apt to be one of porosis about the joint or later sclerosis

more suggestive of arthritic change than of trauma.

Acute cases, apparently sacro-iliac conditions with referred sciatic pains often with exaggerated muscle spasm, yield with fair constancy to rest in hyperextension, belt support, and careful exercises. What the pathology is we do not know. It seems that the more radical measures of fusion of various sorts have shown no encouraging results.

Knowing as little as we do of the pathology of the usual strains, it is well to proceed conservatively, unless an actual diagnosis indicates otherwise. After all, many back injuries fall in the category of what our colored brother calls "miser in de back" and they do well if they are not over-diagnosed and overtreated.



# RECONSTRUCTION SURGERY—THE REPAIR OF SUPERFICIAL

## INJURIES<sup>1</sup>

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AS under the term of reconstructive surgery almost any form of plastic surgery other than cosmetic might be included, the subject would require a complete treatise to do it justice, and as it is one's experience, whether good or bad, which might be of some use to the profession, it is proposed to base this paper on personal experience. All surgery is reconstructive, even though its main primary object at the time be destructive.

### CLASSIFICATION

*Group 1* Many general surgical operations are plastic in character, but a true plastic operation may be defined as one in which new tissue either in the form of a graft or flap is introduced.

*Group 2* Many cases of injury to the face are typified by a displacement of normal tissues without true loss of substance, such as in broken noses and jaws. In this group the main treatment consists in reduction of the fracture, and replacement of the soft tissues, and only in the severe cases is a graft required. It is obvious that accidents of work, transport, and home life are likely to produce injuries falling under Groups 1 and 2.

*Group 3* Those "plastic" or cosmetic operations which involve reduction of existing normal tissues or additions to them are definitely in a different category and may on this occasion be dismissed.

### THE CAUSATIVE AGENCIES AND THEIR RELATIVE FREQUENCY

Group 1 cases require the introduction of new tissue by means of a graft or flap. Burns form the chief causative agent of the injuries, and those occurring in the home are still the most prevalent—clothes catching fire, scalds, hot water bottle burns, and burns acquired during epileptic seizures being the most frequent. Other common causes are burns due to the explosion of spirit and paraffin lamps, to the ignition of celluloid combs, and the explosion of petrol due to static electricity during the dry-cleaning of clothes. Burns associated with other injuries resulting from accidents in motor cars, motor cycles, motor boats, and explosions of acids in chemical works, criminal explosion of acids in chemical works, criminal

Having made this estimate one must then decide on the best method of repair, and if the various alternative methods should be attempted in any individual case, taking into consideration the age, sex, physical, and financial condition of the patient.

**TREATMENT PLAN**

Further, loss cannot accurately be estimated until allowance has been made for the replacement into normal position of those parts that are normal but displaced.

For a successful outcome of the treatment, an accurate diagnosis must be made. This point is emphasized because few surgeons have been trained to estimate by eye the exact loss of skin, muscle, bone, or cartilage that may occur, or indeed the amount of displacement of normal tissues. But it is on these very points that the diagnosis for the reconstruction mainly rests. Further, loss cannot accurately be estimated until allowance has been made for the replacement into normal position of those parts that are normal but displaced.

Presented in the Conference on Industrial Medicine and Traumatic Surgery held at the American College of Surgeons, Boston, October 15 to 19, 1934.

TABLE I—FREE GRAFTS

Type (Fig Nos)	Donor area	Recipient area	Method	Author's reference
Skin grafts				1 2 3
Thin razor grafts (Thin mesh grafts) (Fig 1)	The e grafts are generally taken from the inner side of the arm where it is hairless	Thin razor grafts are mainly used in places where mucous membrane is normally present e.g. in the mouth called buccal inlay or intranasal grafts for contracted sockets in the urethra	Instruments used, Blair or Thiersch knife sterilized board and vaseline the board being used to keep the skin at even stretch. The graft is cut as thinly as possible. Graft applied on stent mold with pressure	
Thick razor grafts	The inner side of the arm or any aspect of the thigh or buttock. Immen c p ees of graft can be cut with a Blair or Thiersch knife	The most common conditions in which these grafts are used are granulating areas of the scalp and forehead cicatricial ectropion of the eyelids \ ray burns of the face and neck and loss of whole skin on the body or limbs. They are particularly applicable for replacement of skin on the hands for webbed fingers \ ray and other burns	Same as for thin except that the graft is cut considerably thicker. Graft applied on stent mold with pressure	10
Dissected grafts (whole thickness grafts)	The inner side of the arm, front of the chest, outer aspect of the thigh back of the ear and upper eyelid	Eyelids and portions of the face in which a good cosmetic effect is specially worth attempting. When successful they are more flexible and of better texture than razor grafts but the percentage of perfect successes is not so great as with the thick razor grafts. Indications for use where there is cicatricial ectropion of one eyelid and not of the opposite eyelid enough skin may be occasionally found to repair the ectropic eyelid. Skin from the back of the ear can readily be obtained, and is useful for eyelids, loss of skin on the nose and other small patches on the face	The skin is excised in anatomical dissection down to but not including the fat. The graft is cut to such a size and shape that when it is sewed into its bed it will be at the tension of normal skin—in other words an exact fit. Pressure applied	
Hair bearing grafts (These are also dis- sected grafts. Care must be taken to include all the hair follicles)	The malar strip	Eyebrows and mustache		
Pinch graft.	The thigh	Clean granulating wounds where a cosmetic effect is not imperative		
Mucous membrane grafts	The mucous membrane of the lower lip and inside of the cheek	Its uses are almost entirely confined to loss of conjunctiva, when there is a normal eye present and particularly in syphilis pharon to form the lining of new eyelids. They also may be used in the urethra	These grafts are usually dissected, but may be shaved with a safety razor. They are usually cut to the size of the part to be replaced and sewed in. Note: Even the thinnest skin graft is likely to grow sufficient hairs to irritate an existing eye.	4
Fat grafts	Fat is usually obtained from the abdominal wall and frequently from the area of an existing scar. The method of type of fat, the less will its bulk be absorbed on grafting	The commonest application of fat method is for bulking up the contour of the cheeks or chin or for inserting beneath a previously implanted skin graft. They may also be used under depressed scars	A piece of fat is cut to the shape required and about 30 per cent larger than finally required to fill the defect to allow for shrinkage. It is then inserted underneath the depression	5
Cartilage grafts (Figs 8 and 12)	(1) Costal cartilage. The free border of the seventh rib is usually taken as it is the thickest and straightest possible. (2) Septal and alar cartilages and the cartilage of the cymba are of great use for minor deficiencies of the nose	Chiefly the bridge of the nose  <i>Example:</i> A curved piece of ear cartilage may be used to give support to a new alar nasi or a new eyelid. Large pieces of ear cartilage may be utilized to give form to a new ear but this type of graft usually has to be taken from a donor		6 14
Osteochondral grafts	The junction of the bone and cartilage in the rib may be utilized with success to form a new bridge in the nose, the bony portion being apposed to the freshened bony portion of the existing nasal bridge	Generally of value in young children's noses. Osteochondral grafts may be used to replace the ascending ramus of the body of the mandible after surgical excision of that area, the cartilaginous portion abutting into the glenoid cavity region and forming a false joint there		
Bone grafts	Usually the ilium	This is the usual method of inserting new bone in the mandible though block tibial grafts have also been used. Osteoperiosteal grafts from the tibia have also been used with success in making a new mandible		11

Cases will occur from time to time in which a completely detached portion of the face and fingers or toes in particular are brought up with the patient having been retrieved and carefully preserved in the hope that the doctor might be able to re-graft the portion. From a naturally limited experience of this type of case it is very definitely recommended to attempt this re-grafting. The illustrations are appended of an authentic case in which the tip of the nose was cut off by a piece of plate glass and sewed back into place 10 hours later. In 3 dog bite cases portions retrieved either from the dog or the ground were re-grafted successfully enough to obviate further treatment. In the third a large portion of the forehead and eyebrow with frontalis muscle was sewed back, but was a complete failure. Advice: Keep the piece



Fig 2 Loss of whole thickness of skin over bridge of nose. Left, immediately after loss; right, after replacement of piece of skin which had been preserved and was sutured into the nose 10 hours after accident



Fig 1 Thin razor graft on mold, for eye socket

the patient. Thus the very young and very old are not suitable for large and complicated flaps. As the forehead skin provides the best type of replacement tissue for any part of the face other than the eyelids, it should be used more readily in the female, who can cover the secondary blemish with her hair, than in the male who cannot do so. Further, the female must often be spared the additional scarring of a pectoral or arm flap when a belly flap is equally available. The male can tolerate a low neck or chest disfigurement with equanimity in order to have a facial or absence of hair must also be taken into account as between the sexes. Both the local and general physical condition should be gauged, the local from the point of view of vitality and infection, and the general from all points of view, not forgetting the psychological. Finally, the financial status enters the problem, and a decision to carry out a presumably inferior method of repair may have to be taken in order to shorten the stay in hospital and the number of operative stages.

It cannot but be admitted that this decision as to method of treatment is one of the most troublesome that can face either surgeon or physician. Should the ideal be attempted with a considerable risk? Should the next best be carried out with less risk? Or should an inferior result be aimed at

at one's decision, the accompanying tables of repair by free and pedicle grafts have been prepared. They are admittedly most incomplete, and savor of that dogmatism which should be absent from the reconstructive surgeon's mind, the guarded use of opportunism is an essential factor in plastic surgery.

However, in order to have a basis for arriving at one's decision, the accompanying tables of will modify the treatment plan.

In this respect it should not be forgotten that the psychological outlook of the particular individual will modify the treatment plan.

the patient, not the condition, must be treated. In this respect it should not be forgotten that the principle of medicine and surgery, namely, that deserves. We therefore return to the cardinal patient and himself the satisfaction that each decision a surgeon will often deny both his and brilliant repair as the last resort. By such a method, leaving the possibly more complicated the patient to try the less-likely-to-be-successful result. It is therefore frequently necessary to tell more troublesome superior method a perfect will always produce the inferior result, or the into consideration. Frequently it is almost impossible to state beforehand that the inferior method the particular problem, but the surgeon's own predictions and experience must also be taken balance sheet be prepared of the pros and cons of with hardly any risk? Not only should a careful



Fig 3 Traumatic loss of nose and lip. Up and down variety (Gillies) of forehead flap

TABLE II—LAPS

[illegible]



Fig. 4 Electrical burn of nose, eyebrow, and cheek. Variety of Gillies "up and down" flap with secondary use of pedicle to form eyebrow and cheek.

#### METHODS OF REPAIR

The cases may be divided into two groups. In Group 1 the repair is accomplished by the introduction of new tissue, in Group 2 by replacement of displaced tissue. In Group 1 free grafts and flaps are used in the repair. By an autologous or free graft is meant the transplantation of a completely detached portion of the body and its reapplication to another. In surface wounds when function and form are desirable the whole of the contracting scar or granulating area should be excised prior to the application of the graft. Surface grafts may, however, be definitely applied to clean granulating areas by one or other of the methods. The functional and aesthetic results depend on so many factors that no purpose would be served by a detailed description of them. Of the various grafts mentioned in Tables I and II, all are uniformly successful except perhaps the whole thickness skin graft and the mucous mem-



Fig. 5 Industrial accident. Partial scalpning. Repair by single pedicle flap. Note the secondary wound was successfully closed by suturing in the scarred epithelium which was removed to accommodate the hairy flap.



Fig 6 Result of early treatment of road accident Acromioclavicular tube pedicle rhinoplasty stiffened with cartilage graft (From *Med Press & Circ* 1934 April 11)

brane graft nevertheless one must bear in mind that there is still a great deal of experimental work to be done in connection with all forms of grafting

The Group 2 cases, in which the repair is accomplished by replacement of displaced tissues, include defects (A) soft tissue injuries and (B) fractures and dislocations

*A, 1 Uncomplicated scars* The repair of simple scars might hardly be included under "reconstruction surgery," but an occasion may always arise when even if the scars have healed well by first intention, or after a primary suture, the result is displeasing and the possibilities of excision and re suture have to be considered

Three main points may be stressed The final repair should not be undertaken before all inflammation has subsided Lymphatic obstruction

should be lessened by skilled massage, and the vascularization of scars increased The value of the pre operative and postoperative X ray or radium treatment, by a skilled therapist, of keloid scars should be borne in mind

The primary scar, or scars, may then be excised together with all the underlying scar tissue, dirt, and foreign bodies In these operations as in all plastic work, tissue trauma caused by the use of heavy instruments, or the clumsy use of light ones, should be avoided Hemostasis is important, hæmatomata being a serious complication There is no contra indication to the use of fine catgut ligatures, but with superficial vessels direct crushing is satisfactory After complete undermining the skin edges may be brought into accurate apposition, and in clean straight incisions one fine subcuticular silk worm gut suture threaded



Fig 7 Traumatic loss of skin of forearm Very large direct flap applied to the forearm.



Fig 9 Factory accident Complete avulsion of scalp, forehead, eyebrows Bilateral abdominal tube pedicle Intermediate host, the wrist, double attachment Trans-

nearly that of normal skin as possible With regard to depressed scars, the insertion of a fat graft may be indicated (see tables, also Fig 11) In the difficult vertically inclined depressed scars of the cheek, if the skin and scars are under-



Fig 10 Transport accident Scarred and displaced soft tissues Repair

Fig 8 Severe unilateral facial burn Repair (1) Thick razor graft for eyelids, (2) right and left acromiopericor-

laps Intermediate host, right wrist

on an eyelidless needle may be used These stitches have the advantage of not passing through the skin edges except at the end and commencement of the incision In certain cases ordinary interrupted stitches on eyelidless needles are indicated These interrupted stitches may be left in from 2 to 4 days, the subcuticular longer, and protection may be afforded by a light gauze dressing applied with even pressure by mastisol or elastoplast fixation As regards the postoperative care, the patient can improve these scars by self massage with sterile paraffin (Fig 10)

A, 2 Complicated scars One would include in this section irregular, V-shaped, U-shaped, and depressed scars The same principles are involved in their repair as in that of uncomplicated scars There is frequently cicatricial contraction affecting the surrounding structures, and when released a gap is left which must be replaced by a simple advancement or transposed flap During the suture of these flaps, care must be taken to ensure that they have a sufficient blood supply, and when re-sutured they should be under tension as

HAND INFECTIONS IN INDUSTRIAL ACCIDENTS<sup>1</sup>

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VARYING with the industry, as shown by insurance statistics, hand infections still are responsible for from 5 to 9 per cent of all total disabilities. Were it not for these startling percentages I would not presume to discuss with this body of surgeons, whose primary interest has been the care of industrial accidents, some of the simple principles of surgery of the hand in relation to infections. Of the total hand disabilities 20 to 50 per cent arise from infections, a large proportion of these having their inception in trivial injuries. This number can be markedly reduced by a more widespread appreciation of the potential danger, a more intense campaign of education of the employee as to the importance of caring for simple injuries, of employers as to the economic value of prompt and efficient treatment, and of the profession as to the basic principles of diagnosis and treatment.

Certain etiological factors that should always be borne in mind have a peculiar application to industry. Employees as a rule live an indoor life have little sunlight and often poor food. They are therefore debilitated and favorable subjects for the spread of infections. In cold climates we see this most often in the late fall or early spring, and in warm climates after the intense heat of the summer. During these periods the danger of virulent infections is increased especially in the freezing and melting period, due to the prevalence of influenza, tonsillitis, and similar infections with resultant streptococcic contamination of the blood stream.

Another factor is the ignorance on the part of employees that leads to primary inefficient or even harmful treatment such as neglect and fellow employees' treatment of simple injuries, as for instance the removal of splinters. It must also be admitted that too often the attending surgeon, who would be vitally interested in a major injury, pays too little attention to these small injuries, especially in the follow up.

Again employees are peculiarly liable to trauma of the hands and to cracked calluses, both of which are fruitful sources of infections.

It has been found that certain types of infection are peculiar to certain industries. For example, confectioners, who handle fermenting fruits and spray them with sugar, and cooks and bartenders, who deal with fermenting grain and vegetables, are peculiarly liable to paronychia. In such cases

the nail loses its luster, turns dark, and is finally lost. A persistent chronic inflammation of the nail bed continues for weeks and months. If the cause is recognized and the occupation changed or if rubber gloves are worn, the condition heals promptly. The surgeon caring for the patient has not done his duty until he has apprised the employer of the danger and taken steps to prevent the infection in other employees.

Office workers not infrequently accidentally break off pieces of indelible pencil which lodge in the skin. Ill advised attempts to remove the soft lead end in breaking it and fragments are left. The presence of these fragments results in local necrosis with chronic recurring local infection. In such cases the imbedded pencil parts should be removed by incision, if left until necrosis begins, the necrotic area including the fragments should be excised. We have had an exceptionally large number of severe infections in nurses due to inadvertent pricking of the finger with pins.

A type of infection not often recognized is that found among those who milk cows or tend cattle—the so called milker's nodule. The infection is caused by cattle hair entering a crack in the skin or being introduced at the time of an injury. Cattle hair has spines placed obliquely to the hair—somewhat like pineapple spines—and these hairs tend to work deeper into the tissue instead of being expelled as usually happens with foreign bodies. A local recurring infection that may last many months results and will not clear up until the hair is removed.

In the treatment of hand injuries, we have in our clinic come to rely on the meticulous application of certain procedures which we believe to be important—some of these are often neglected.

Severe injuries are treated promptly, hence infection does not often occur. If it does occur adequate drainage is provided. Any disability resulting is generally due to the primary injury or loss of tissue. The converse is true of the trivial injury.

In severe injuries we avoid primary antiseptic treatment, cleansing the wound only with soap and water unless grease is present, when some solvent is also used. We are also strongly in favor of debridement and primary closure of the wound if the treatment has been prompt. We also suture the tendons and nerves at this time if we do not fear infection. Where some hours have elapsed

<sup>1</sup>Presented in the Conference on Industrial Medicine and Traumatic Surgery during the Clinical Congress of the American College of Surgeons, Boston, October 19, 1934.



or we fear infection we favor leaving the wound partly open for drainage, a procedure which ensures at the end of 48 hours we close such a wound and reopen after healing for the entire of the tendons and nerves. Gas bacillus infections are the cause of too

many fatalities due primarily to lack of careful observation and prompt treatment, and also to the fact that too much emphasis has been placed on the terminal picture of crepitation and evidence of gas spread during the tissue. The time for the injection of gas bacilli is either immediately after a deep hypodermic incision or, in those cases in which the wound or in the incision crepita is present, as soon as the wound is treated with X-ray, we have a delayed local demonstration by X-ray, in any case, to avoid delay in obtaining a more important assurance is the escape of the gas as seen when the dressings are removed.

When we come to the question of treatment of the ordinary simple injury, the factors that have militated against prompt recovery are often found in the neglect of proper primary treatment. Such neglect may be due to the desire on the part of the patient to continue work, to the disinclination of the surgeon to place the patient on disability pay, to failure to realize that trivial injuries more often than haccared wounds lead to loss of life and permanent impairment of ability to do a job of work. Knowledge of application of the basic principles of treatment in immediate treatment in the way of forcing the patient into hospitalization, prompt removal of splinters, and the application of such things as such as iodine when much less the incidence of infections. Our essential line of defense must be the local and general resistance of the patient.

the importance of the patient's participation in the decision-making process. The importance of the patient's participation in the decision-making process is emphasized in the importance of the patient's participation in the decision-making process. The importance of the patient's participation in the decision-making process is emphasized in the importance of the patient's participation in the decision-making process.

There are many other factors that lack of time prevents me from considering. Among them may be mentioned the wide and not evident injury to tissue in the electrical burn, the lack of appreciation of the peculiar anatomy of the metacarpophalangeal joint and its relation to prolonged infection.

Another simple, but not obvious, way to reduce the cost of insurance contracts is to make the contract more flexible. For example, a contract that allows the insured to choose the level of coverage or the deductible can reduce the cost of insurance. This is because the insured can choose to purchase a contract that is tailored to their needs, rather than a contract that is designed to protect against the worst-case scenario. This flexibility can also reduce the cost of insurance by allowing the insured to adjust their coverage as their needs change over time.

and even though the infection is controlled, I cannot demonstrate that the virus is not transmitted by simple contact or voluntary or involuntary application as to place the virus in the position of infection. A large percentage of the virus is probably lost when following simple disinfecting, and we have been able to demonstrate this simple rule. Also, we have seen that in case of the demonstration of the presence of infection on the dressings and on the undersides of the patients, the demonstration of the work of Hudack and Altmann has demonstrated the spread through the lymphatic system, and we have seen that the virus is spread from the site of the wound and spread with almost the same rapidity. Therefore any virus in non-located abscesses, except in phlegmonous infections, will not spread and will be positively harmless.

Failure to differentiate them may lead to an ill advised incision in lymphangitis with not infrequent unnecessary complications and death, or, on the other hand, delay in drainage of the tendon sheath may result in loss of the tendon and prolonged convalescence. Most of the deaths we have seen have been due to ill advised incisions in lymphangitis and the greatest proportion of severe disabilities have had their origin in suppurative tenosynovitis in which drainage had not been promptly instituted.

Finally may I discuss some of the broader aspects of the question. While adequate education of employees and employer has been established in many of our large industries there is still much to be done. Every surgeon having responsibility for the care of any plant no matter how small should not consider his duty done when he has cared for the injured man. He should analyze his accident cases as to the causes and immediately take steps to prevent a recurrence.

He should establish such co-operation with plant managers as will permit his intimate knowledge of conditions about the plant that may favor injuries or infections.

The casualty companies check carefully as to elevator weakness, explosive mixtures, open machines and similar evidences of gross negligence but too often no one checks the plant for the source of common simple injuries and I doubt if any one but the doctor can do this. Each plant is a problem in itself. Wire ends on boxes, exposed fragments of tin, splinters on bins, pins on packages and projecting nails cost the insurance companies a score of times more for disability expense than do elevator accidents.

In a certain plant Mock noticed that minor scratches with subsequent infection were often due to the lining of bins that had become splintered by use. The department manager was warned and in one year the injuries from this source were reduced 86 per cent.

Employees and foremen should be educated by lectures and posters of the dangers and have knowledge of the procedures immediately necessary in case of accident. Fellow employees' help with splinters should be avoided and the employee taught to see the doctor or nurse, or failing these to apply iodine at once.

Employers and insurance companies should be educated as to the financial saving by prompt treatment and early hospitalization in case of doubt. This latter is of vital importance. Deaths and morbidity arising from infections following

simple injuries in a majority of cases occur in ambulatory cases. Mock reports that in 250 serious cases treated by ambulatory methods 83 per cent required incisions, and in 150 serious cases treated with prompt hospitalization only 53 per cent required incisions.

This emphasizes not alone that hospitalization is important but also that the surgeon should arrange for an adequate follow up of his simple injuries so that he may know, not tomorrow, but immediately, if infection is developing and be able to institute prompt and efficient treatment. Such close follow up, except in few instances is now seldom instituted.

There are 4 parties interested in an industrial accident—the employee, the insurance company, the employer, and the doctor. The employee's interest is in the patient himself and his compensation, the insurance company's, in economic factors, and the employer's and doctor's, in both. This quadrilateral interest has led to some confusion, misunderstanding, and not infrequently to inadequate care. Each party has felt his interests might be jeopardized and has fought against imposition. I need not elaborate upon malinger of the patient, the pressure of insurance companies to cut legitimate charges with its consequent temptation to padded service and fees, the difficulty of convincing insurance companies and employers that a larger primary expense for prompt hospitalization and efficient treatment is cheaper in the end, the inefficiency of service when the patient and the insurance company each feel their interests are opposed and act accordingly. The doctor cannot serve two masters when each demands a different service.

In reality, however, I am convinced that each party is willing to do his part. All wish efficient service and it is the doctor who by giving it can harmonize the divergent attitudes. I venture the assertion that if the industrial surgeon will give a more imaginative service, will assume the responsibilities I have mentioned, not alone treat his patient, but by adequate analysis find the frequent causes of such accidents in any given plant and take steps to prevent them, will institute personal plant investigation with recommendations as to how accidents may be prevented, and will foster educational programs designed to lessen the consequences if they occur, not alone will accidents and infections be lessened but many of the social and economic difficulties causing friction between the 4 groups interested will disappear.

# OPHTHALMOLOGY AND OTOLARYNGOLOGY

## VASCULAR CHANGES IN THE RETINA

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A SERIES of original photographs of the ocular fundus were presented and a demonstration was given of several variations from the normal tortuosity of the retinal vessels is in itself not a sign of disease was emphasized. Diseases affecting the blood vessel walls can be promptly recognized by early changes in transparency. This was well portrayed in the pictures of cases with patches of sclerosis and in others of extensive arterioma. The sudden occlusion of the central retinal artery—so called embolism—was also illustrated and discussed, and the rapid closure of the central retinal vein—so called thrombosis—was described with the aid of several slides. The demonstration of the circulation in and about the macula included arteriosclerotic changes in the retinal and also in the underlying choroidal vessels. Due emphasis was laid upon the impossibility of definitely diagnosing optic nerve lesions simply by the color of the disk. The value of stereoscopic fundus photographs was emphasized, they afford the most exact and earliest evidence of fundus changes, including the optic nerve expression of intracranial disease.

## SIMPLIFICATION OF PROCEDURE IN PLASTIC SURGERY ABOUT THE EYES

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THERE is a tendency for plastic surgeons to think complexly, plan complexly, and operate elaborately. The simpler plastic procedures lined with epidermis, it will be clean, except for a little exfoliated epithelium, which is easily removed from the skin lined socket. There is no need for the surgeon to use pedunculated grafts in the reconstruction of an obliterated eyelashes, strips from the lower part of the brows can be transplanted. These do not have to be pedunculated. For obliterating false passages between skin surface and nasal cavity, pedunculated flaps from the upper lid should be used. These should be lined with skin epithelium a few weeks before flaps should accurately fit the opening and it should be free from hairs. For restoration of brows, skin from the occipital scalp serves fairly well. Pedicles are not necessary. Abstract of paper presented before the Section on Ophthalmology, Clinical Congress of the American College of Surgeons, Boston, October 16, 1914.

CLINICAL STUDIES IN SLIT-LAMP OPHTHALMOSCOPY<sup>1</sup>

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From The Wilmer Ophthalmological Institute of the Johns Hopkins University and Medical School

THE slit lamp ophthalmoscope is an instrument which combines the highest attainable clarity in the ophthalmoscopic image with the possibility of oblique focal illumination of the posterior segment of the eyeball. The advantages of oblique focal illumination for the examination of transparent and translucent media have been well known in ophthalmology for a long time and the application of this principle in the development of the corneal

microscope has been a great clinical and scientific advantage. It is to be hoped that similar advantages may result from the application of the same principle to the examination of the posterior segment of the eye.

Lantern slides were presented which showed the appearance of the posterior portion of the vitreous, hyaloid membrane, retina, optic disc, and choroid in normal and various abnormal states.

INTRAVENOUS TREATMENT OF DISEASES OF THE UVEAL TRACT<sup>2</sup>

WILLIAM L. BENEDICT, M.D. AND PAUL A. O'LEARY, M.D. ROCHESTER, MINNESOTA

IT would appear from the clinical data so far assembled that the optimal time for commencement of treatment by gold salts in cases of iritis, iridocyclitis and scleritis is after subsidence of acute inflammation in the anterior segment of the globe. Before that stage we believe that other more effective remedies can be used. In any event, every means at our disposal for improvement of the patient's general health is employed.

Patients who improved under tuberculin therapy were not given gold salts. The selection of patients for intravenous administration of gold included many in whom clinical or biological evidence of active tuberculosis could not be demonstrated. Gold sodium thiosulphate is given intravenously in courses of approximately 20 injections. It is our practice to start with 10 milligrams and increase the amount slowly until the patient is receiving 30 milligrams twice a week as the maximal dose. If

the patient shows the slightest sign of intolerance, use of the drug should be discontinued temporarily and when its use is resumed the dose should be half of that which produced the reaction. We have found it advisable to prescribe a rest of 2 months following a course of 20 injections; a similar series of injections may then be repeated if the response has been inadequate.

The drug is poorly tolerated by the markedly debilitated patient, by one with advanced, active, febrile pulmonary tuberculosis and by patients with advanced hepatic or renal disease. For pregnant women the dose of the drug should be smaller by half than that ordinarily given. A reaction may appear immediately or be noted a considerable time after injection. Treatment thereafter should be cautious or should cease. Using this method of treatment in ophthalmological cases we have had no complications.

<sup>1</sup>Abstract of paper presented before the Section on Ophthalmology, Clinical Congress of the American College of Surgeons, Boston, October 15, 1914.

<sup>2</sup>Because of lack of space considerable important material has been omitted from this abstract. The material will be included in the author's reprints. Paper presented before Section on Ophthalmology, Clinical Congress of the American College of Surgeons, Boston, October 15, 1914.

## THE CLOSURE OF THE CATARACT INCISION

CHARLES NELSON SPRATT, M.D., F.A.C.S. MINNEAPOLIS, MINNESOTA

It is a well recognized surgical principle that, unless drainage is indicated, operative wounds should be sutured and not left for nature un-

aided to make the closure. Rapid healing is thus obtained, infection is avoided and the danger of postoperative hernia is reduced to a minimum. Incisions into the cranial cavity, abdomen, or thorax, are sutured. Why should an incision in the eye remain unsutured?

After the ordinary cataract section, the edges of the wound tend to adhere. We all know, however, from past experience that such a closure is not free from complications, such as delayed union, reopening of the wound by coughing and straining, downward growth of epithelium into the anterior chamber (Fleisch has demonstrated this) prolapse of iris, vitreous loss, explosive hemorrhage and late infection.

The use of a suture after the cataract operation was suggested by Williams of Boston in 1867. Since then many modifications have been described especially by Kell in 1894 and Van Lint in 1911. The extraction of the lens beneath a bridge of conjunctiva was, according to Schwegler, suggested in 1858 used by Desmarests in 1881 and published in 1895.

Husum, in 1918, described a conjunctival flap method in which an opening in the anterior chamber was made with a keratome and the angles were emphasized with scissors. Holbrook Lowell of Boston reported, in 1920, a series of operations done after this method. A modification of this sutured pocket-flap has given me the least number of operative and postoperative accidents. As the method has been described elsewhere (3) only a brief account is here given.

A horizontal incision, 15 to 20 millimeters long and 5 to 8 millimeters above the limbus, is made in the conjunctiva. This is dissected to the limbus and down on each side with blunt scissors to nearly a level of a horizontal line, thus forming a deep pocket. A mattress suture of fine silk on a round needle is placed in the conjunctival edges and the loops of the suture are placed on each side so as to be out of the field of operation. A suture is placed in the superior rectus as suggested by Angell. Holding the flap of conjunctiva with blunt tissue forceps, this securing a point fixation, an incision is made at the limbus and beneath the conjunctiva with a narrow Græfe knife. If the incision is too far back, an indolentomy results. If too far forward, a buttonhole is made in the conjunctiva. These accidents are to be avoided, but an indolentomy is not objectionable and a buttonhole changes the operation to that generally done when no conjunctival flap is made. The anterior capsule is removed with tooth forceps by holding the flap of conjunctiva forward, the

edges of the wound are separated and the lens is expressed with a spatula. If cortex or blood remain, the anterior chamber is irrigated. The suture is tied and the wound is secure.

The lens may be extracted, in this type of incision, with forceps, by tumbling, by traction, by vacuum extraction may be used and irrigation may be employed if indicated. During the delivery of the lens the traction on the conjunctival flap not only fixes the globe but also enlarges the wound and thus aids in the exit of the lens. There is less danger of vitreous prolapse than in the usual method when the two spoons are used, the one to express the lens and the other to make a backward pressure on the scleral portion of the wound. In case vitreous

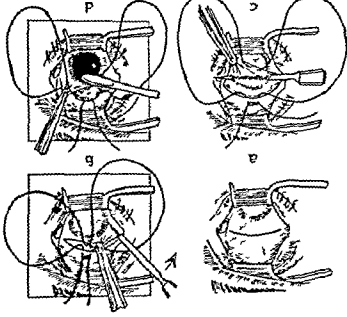


Fig. 1. Cataract extraction pocket flap method. a, The incision in conjunctiva, b, conjunctiva pocket made, mattress suture in place, flap held up to secure fixation, c, counter puncture made, flap held down to secure visibility and to fix the globe, d the incision completed at the limbus, the lens is expressed, e, wound is closed.

presents, the eye can be immediately closed without loss of contents just as when loops of intestine present in an abdominal section. The opening in the globe is made in a clean field and thus the possibility of infection is reduced to a minimum.

This operation differs from other methods of suturing as suggested by Williams (1867) Kalt (1894), Czermak (1903), Van Lint (1911), and other writers, in that there are no open angles to the wound and should prolapse of iris occur, the latter is protected by the layer of conjunctiva. There is no danger of late separation of wound edges as the sutured flap is as firm in hours as the unsutured wound is in days. Delayed healing is thus avoided. The down growth of epithelium into the incision and anterior chamber is not a possible complication since no epithelial margins are exposed the incision being beneath the conjunctiva. The astigmatism is less after an incision of this kind than when the opening is made at the limbus or in the cornea. Convalescence is rapid and safe most patients are out of bed the day after operation. The danger of late infection is reduced to a minimum.

The only objections to this operation are that there is lack of visibility, the operation is longer, the suture requires removal and there is slightly more bleeding. The lack of visibility is more fancied than real. Three minutes increase in the time of operation saves days in bed and reduces the time of hospitalization by one half. The removal of suture is necessary after any operation and needs little consideration. Bleeding into the anterior chamber is objectionable but not serious as the hyphema is quickly absorbed.

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limited to a competent pathologist. History by direct  
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with these one must possess a knowledge of broncho-pulmonary and œsophageal diseases, together with a general appreciation of chest diseases in addition to experience with laryngological problems.

The untrained endoscopist who does an occasional bronchoscopy or œsophagoscopy has few successes to report. He subjects his patients to unjustifiable hazards. In no field of medicine do end results bear such a definite relationship to training, skill, teamwork, and other factors. In foreign body work the end results are positive. Either the foreign body is or is not removed, but injury to the patient may convert an apparent success into a failure.

To the uninitiated certain foreign body cases, notably coins or safety pins in the cervical œsophagus, appear to be easy. Nothing could be more misleading. All foreign body cases should be considered difficult since a certain degree of special training and skill are necessary for successful removal. The difficulty in removal seems to increase as the skill of the endoscopist decreases. Unfortunately the unskilled are often called in to handle emergency cases. These cases generally call for the highest degree of judgment and skill and should be undertaken only by one who is competent. It is far safer to do a diagnostic bronchoscopy in a case of suspected bronchiectasis than to attempt to remove a difficult foreign body from either air or food passages.

Any physician contemplating the practice of peroral endoscopy should prepare himself by special training under competent guidance until he has mastered the

ordinary technical difficulties. This should ultimately include a course of training on the living patient. In addition, he should be familiar with the practical clinical aspects of the subject. While much of this can be gained from medical literature, one's fundamental training should be supplemented with actual clinical experience. The matter of equipment is a common stumbling block. A careful selection of instruments is highly important and one cannot economize on the essentials. Diameters of tubes and lengths of forceps must vary as do the anatomical measurements of air and food passages in infants, children and adults. To attempt to pass an adult bronchoscope in a child bespeaks absolute ignorance of the fundamental principles of bronchoscopy. One should use tubes suited to the patient and the problem under consideration. This applies to all other instruments. The use of suitable equipment is fundamental in peroral endoscopy and is the only way to practice economy in saving human lives.

To summarize, peroral endoscopy in its broadest application is a field for the otolaryngologist. The scope of the work is as diversified as the diseases of the tracheobronchial tree and œsophagus are. A knowledge of the general medical aspects of these organs should be considered necessary. One engaging in peroral endoscopy should be thoroughly trained in the technical phases as well as the clinical application of the subject. An adequate physical equipment is indispensable.



THE RECOGNITION AND TREATMENT OF ONE TYPE OF MENIERE'S DISEASE

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THE term Meniere's disease as used in this paper does not imply a hemorrhage into the inner ear but is descriptive of the symptoms. This paper describes the otological findings in 40 patients with Meniere's disease. The symptoms in each of these patients were (1) tinnitus—usually limited to one ear, (2) impaired hearing—usually limited to one ear, and (3) violent and sudden attacks of vertigo. In 37 patients in this group the entire auditory nerve (cochlear and vestibular) was divided intracranially by Dr. Walter Dandy. In the 3 remaining patients only the vestibular nerve was divided. The damage to the auditory or facial nerves has been successfully carried out on 10 additional patients since this paper was written. In every case the division of the vestibular nerve promptly stops the attacks of vertigo. The etiology of the disease is unknown, but there are many factors which suggest that the lesion is not located in the cochlea, but either in the nerves or the more central auditory and vestibular tracts. At any rate the division of the vestibular nerve, which severs the connection between the end organs in the inner ear and the division of the vestibular nerve on the one side, or on both sides if necessary, is the treatment of choice, and in the last 13 cases this operation stopped the attacks of vertigo without further impairment of hearing.

Intracranial division of the vestibular nerve on even years during which the patient is entirely free from the attacks of vertigo.

It is characteristic of Meniere's disease that there are remissions, or long intervals of several months or even years during which the patient is entirely free from the attacks of vertigo.

It is characteristic of this disease that there is value in the diagnosis of this disease. In our experience the results of vestibular tests are of little value in the diagnosis of this disease. In our times it is very subnormal or entirely absent. In our active, sometimes the response is normal, and sometimes with the caloric test are sometimes by per-  
The semicircular canals on the affected side with attacks of vertigo was the deafness complete and bone conduction is shortened or nil. In no case with Meniere's disease is of the inner ear or nerve and bone conduction is better than bone conduction, type. Air conduction is better than bone conduction, type. The characteristic hearing defect in these patients always stop the attacks of vertigo just as the division of the sensory root of the fifth nerve will stop attacks of trigeminal neuralgia.

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Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of American College of Surgeons, Boston, October 17, 1934.

## THE DIAGNOSIS OF CHRONIC INFECTION OF THE TONSILS IN RELATION TO INDICATIONS FOR OPERATION IN CASES OF CHRONIC FOCAL INFECTION<sup>1</sup>

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**I**NTEREST in this subject has been revived by a number of symposia, held in England by the Fellowship of Medicine recently under the conduction of Tilley, Glover McKenzie, and in this country by I W Dean at the 1934 meeting of the American Medical Association, by Kaiser Nissen and Mosher at the American Academy meeting, and by the writer and William Gordon in the spring of 1934 before the Philadelphia County Medical Society.

Adverse criticism has been levelled at the profession because of the practice of indiscriminate removal of the tonsils.

To settle these questions, it is necessary to study carefully the clinical anatomy the physiology, and the histopathology of the tonsils, and correlate these with organic disease produced elsewhere. It is also necessary to define clearly what constitutes a diagnosis of tonsillar infection. It is generally accepted that the tonsils may act as a portal of infection for other parts of the body as well as constitute a primary cause for infectious processes of focal origin elsewhere in the body but it must not be forgotten that the infected tonsils may be only one of several such agents. Pemberton has shown that 50 per cent of a group of arthritics recovered or improved even in the presence of such a focus.

Often, removal of infected tonsils fails to give relief because other foci of infection that are present are overlooked. Thus foci may exist in the teeth, sinuses, ears, gall bladder, gastrointestinal tract, prostate, etc. Often individuals may carry septic tonsils for years and show no evidence of disease processes elsewhere from this focus of infection because the resistive powers of the individual are great enough to counteract the toxins fed into the system from the tonsil infection. Any lowering of the resistance or increased virulence of the infection may upset this balance so that symptoms due to focal infection may manifest themselves.

Clinically the following points may be accepted as proper criteria for the diagnosis of septic tonsils though some authorities may lay more stress on different individual points: the history of local tonsillar inflammation, acute or chronic. Hajek's dictum—repeated attacks of acute tonsillitis, one or more attacks of quinsy, repeated coryzas beginning with sore throat, soreness or discomfort in the tonsillar region, cervical adenitis (dental sepsis eliminated), enlargement or tenderness of the tonsil node at the angle of the jaw, gross hypertrophy of the tonsil, the anterior pillar having an inflamed, reddish or purplish hue, especially at the upper part, liquid pus expressed from one or more crypts by

drawing the anterior pillar forward and outward and pushing behind the tonsil. Pus may be often found in the crypt of the upper pole. Aspiration may be useful. A tonsil that is firmly attached to its fossa suggests a previous quinsy, many attacks of acute infection, or a long process of chronic infection. Simple tonsillar hypertrophy with enlargement of the cryptal orifices often shows eventually small ulcerative congestive lesions at their borders. Bacteriological examination, if a streptococcus is recoverable, is accepted by some as strong confirmation of other signs and symptoms. Caseous masses should place a tonsil under suspicion. At times these masses are accompanied by liquid pus. The masses themselves do not warrant tonsillectomy except for social reasons such as bad breath. Small purulent collections concealed in the crypts by inflammatory adhesions often plainly seen, are diagnostic.

We cannot with any assurance say that a given tonsil is not infected unless it is proved so by bacteriological and pathological investigation after removal. How often do we see pus gushing from the crypts after applying the snare or guillotine to a fairly innocuous appearing tonsil?

Having made the diagnosis that a given tonsil is infected, we must decide whether it is actually causing damage or is likely to cause it in the future.

Regarding prophylaxis opinions vary. Kaiser states that prophylactic tonsillectomy did not make for great immunity to recurrent infections of the respiratory tract to contagious disease or rheumatism. Horace Williams in the Philadelphia Hospital for Contagious Diseases showed conclusively that the children who had middle ear suppuration and complications almost without exception had not been tonsillectomized.

McKenzie doubts the value of statistics used to disprove the value of tonsillectomy. He asks whether the tonsils were completely removed, whether in some cases, only adenoids were removed, or whether there were regrowths or recurrence of the lymphoid tissue.

Herbert Tilley states that a septic tonsil should be removed but deprecates the wholesale removal of tonsils without a careful study of the case.

Tonsillar sepsis in relation to focal infection and distant pathological conditions requires the co-operative study and observation of the otolaryngologist and the attending physician. A connection between the infected tonsils and the distant disturbance should be proved if possible. The study should be extended to all parts of the body as insisted upon by Nissen. Close clinical observation over a considerable period of time by the physician

<sup>1</sup>Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 17, 1934.

plus frequent reports of subjective symptoms by the patient, are essential to determine the association between the local and systemic infection. The diagnosis of tonsillar infection rests with the otolaryngologist, but the most careful and meticulous study of the case as regards the relationships between the local and systemic infection will depend on co-operation on the part of the otolaryngologist with the attending pediatrician, internist, or surgeon.

## THE PRESENT STATUS OF INFECTION OF THE UPPER RESPIRATORY TRACT IN RELATION TO FOCAL INFECTION<sup>1</sup>

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Cleveland Clinic

In the evaluation of the importance of focal infection in various systemic diseases, careful study and rational judgment should replace illogical jumping at conclusions. Because a focus of infection is discovered does not mean that it is causing the patient's symptoms, or that its removal will cure him. This may be coincidental.

The relative importance of the various foci of infection are as follows: teeth, tonsils, prostate, crani, vi, gastro intestinal tract, and sinuses. Absorption from teeth is more likely than from other foci because of their anatomical structure and the fact that the infection is well locked in. Tonsils are likely to be an important focus of infection and their removal is indicated often for prophylaxis even when no causal relationship can be demonstrated between the disease and the tonsillar infection. Sinuses are less likely to be a factor in focal infections, and their importance has been greatly overrated by some specialists. If there is infection of the sinuses, conservative treatment should always be used before operations, which perhaps are unnecessary, are resorted to.

Among the diseases in which focal infection has been emphasized as a causative factor are infectious arthritis, rheumatic fever, chorea, valvular heart lesions, nephrosis and nephritis, and hypertension. In my experience the removal of foci for nephrosis aids, etc.

The warning is reiterated that operations for the removal of foci should be performed only after careful study of the patient and the correlation of all factors which are contributing to his illness. The fallacy that tonsillectomy is a panacea for all conditions, such asitis and inflammation of the uveal tract. In my opinion, papilloedema and neuritis of the optic nerve are not due to infection in the sinuses.

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Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 17, 1934.

# THE CELLULAR CHARACTER OF ONE HUNDRED TEMPORAL BONES CLINICAL AND SURGICAL SIGNIFICANCE<sup>1</sup>

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**T**HE embryological development, histological character, and anatomical configuration of the temporal bone is of prime importance for a clear conception of its cellular system, the pathological changes it may undergo and proper therapeutic application. It is a composite structure composed of a squamosal and a petrosal portion, the former a flat bone the latter a long bone. This gives it an individualism of its own. Within compact osseous walls is primarily diploetic tissue, which may be modified by age, biological factors, systemic disease or early infection in the middle ear cavity. Though the temporal bone contains the otic capsule with other important structures the change that it may be subject to is one of bone pathology, and its surgical therapy should be based upon this principle, modified and altered to meet the special anatomy of that portion of the structure involved.

The apex is similar to the epiphysis of other long bones and subject to the same pathology that may occur in similar structures. It may be invaded from the middle ear or mastoid antrum, by continuity of tissue or by vascular transmission, also from pathological conditions extraneous to the temporal bone. It is one of a localized purulent lesion, or one of osteomyelitis. Clinical evidence of abducens paralysis, facial or retrobulbar pain in the presence of middle ear or mastoid disease is indicative of petrosal tip pathology. The rationale of the proper surgical treatment depends upon a knowledge of such pathology.

The following is a summary of the gross observations relative to the cellular character and anatomical location of one hundred temporal bones sectioned in various planes. The terms anterior, inferior, and posterior are used in relation to the three surfaces of the pyramid. The mixed type is placed under the caption that represents the predominant type of cell present. From these observations referable to the surgical anatomy with its clinical and surgical application the following conclusions are presented:

1 From the observations presented, the cellular character of a majority of temporal bones is the mixed type.

2 The petrosal tip however is predominantly diploetic.

3 The diplo-pneumatic cell type was found to be the most prevalent in the mixed cell type.

4 The cellular character of the mastoid is not a true index to other portions of the temporal bone.

5 The surgical anatomy as presented leads to the inference that the most prevalent route of invasion

to the petrosal tip is from the mastoid by way of the posterior aspect of the pyramid, then by way of the anterior surface from the zygoma, or the petrotubal or carotid canal directly from the middle ear, and finally by way of the retro-facial area via the bulb cells.

6 Petrosal tip pathology may occur by way of continuity of tissue or by vascular extension from infections in the middle ear or mastoid also from pathology extraneous to the temporal bone.

7 The petrotubal cells serve as a route of evacuation rather than one of invasion to the tip.

8 The logical approach for drainage to localized purulent pathological conditions in the tip is by way of the petrotubal cells, and for osteomyelitis a subdural approach either from the mastoid or directly by way of the middle fossa.

9 The variance in the surgical anatomy of the temporal bone impresses one with the fact that clinical evidence, based upon the pathology present, should be the guide to type of therapy used.

## SUMMARY OF FINDINGS OF 100 SPECIMENS

No. temporal bones	Anatomical location	Cellular character		
		Diploetic	Pneumatic	Sclerotic
100	Mastoid	9	28	5
	Mixed	—	—	—
	Total	15	59	10
	Zygoma	18	21	7
	Mixed	—	—	—
	Total	40	40	20
	Pyramid			
	a—Anterior	11	17	5
	Mixed	—	—	—
	Total	44	45	10
	b—Inferior	24	14	8
	Mixed	—	—	—
	Total	48	33	20
	c—Posterior	18	13	6
	Mixed	—	—	—
	Total	35	53	22
	Tip	75	6	1
	Mixed	—	—	—
	Total	87	12	2
	Bulb cells	33	14	12
	Mixed	—	—	—
	Total	53	28	29

<sup>1</sup>Abstract of paper prepared for presentation before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 18, 1914. (Dr. Ziegelman passed away en route to the Congress.)

RECENT DEVELOPMENTS IN THE DIAGNOSIS OF MENINGITIS<sup>1</sup>

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of work. Very little progress has been made and today meningitis is still the unsolved problem in our field of medicine.

Before advance can be made, it will be necessary to restate fundamentals and postulate upon these a new conception of this lesion, and with this in view I present the following for consideration.

A. The meningial inflammation, including the inflammatory reactions of the brain tissues, is the result of bacterial infection which most often reaches the affected parts by the route of the blood stream, traveling either directly by way of the perivascular spaces or, because of a spread endocranially, by a regression thrombosis from the veins of the mastoid process, the petrosal pyramidal, or the perivascular channels in the labyrinth, which latter structures must have been involved in the infection before-hand.

B. Performed anatomical structures may also be the tract used by an invasion to reach the meningies, but, in each case, before such shall be accepted as the route involved, histopathological proof must be acquired.

C. Meningitis is a generic term which has the sanction of usage. It is to be understood as describing a lesion which exhibits inflammatory reactions to bacterial invasions involving the meningies, the brain substance, and the choroid plexus.

D. Cases of otogenic meningitis differ in patients of differing ages. A perusal of the literature shows that the lesion is more apt to resolve among the young than when it occurs among older individuals. There are more recorded recoveries among children than among adults, and in these the meningitis is apt to develop without the intervention of a purulent mastoiditis.

E. Clinical evidence stresses the fact that the symptomatology is grossly divisible into two groups of symptoms: (1) those due to increased intracranial pressure, and (2) those due to toxicity, including the terminal sepsis from bacterial activity. If the predominating symptoms are those of pressure, this must be relieved early, but cure will not result until the other factors listed are also mastered. Time is gained, however, if the pressure element is relieved, to carry on measures to combat the other factors.

Before one enters into a discussion of the recent developments in the diagnosis of meningitis, it is necessary to clarify some misunderstood standards concerning old concepts. There are many problems concerned in otogenic meningitis. It has been customary to limit our view to the finding of a specific invading organism in the cerebrospinal fluid, to the clinical manifestations which the tissue reactions produce in the form of symptomatology, and to autopsic findings.

The desirability of very early diagnosis has been stressed and yet the evolution of the meningial lesion has not been accorded its grave significance in the earlier stages of its development. The fact has been overlooked that the evolution of the meningial lesion may be halted before data which are usually accepted as of diagnostic import are available. Finally, we have performed anatomical channels of the middle and the inner ear spaces and have accepted them as the obvious tracts along which an infection must travel on its way to the meningies without, in many cases, having established beyond any reasonable doubt that the endocranial invasion was spread by these routes, and we have accepted recorded cases as otogenic without histopathological proof of such invasion. On the other hand, the general principle of infection by retrograde thrombosis and by metastases along blood channels has escaped our serious consideration.

Not have we studied the cases which have recovered from meningitis in sufficient detail and accorded them the notation which the data they presented merit. We have not a general knowledge of those aspects of the clinical picture which drop out in the records of our recoveries. We have been too prone to question the diagnosis in recovered cases. Nor have we always accepted a diagnosis of meningitis unless it gave undoubted evidence of bacterial content in the spinal fluid. We believed that the lesion was of different nature with the differing bacterial content, and while it is true that we studied cytology, we held that the finding of one class of cells as against another type of cell content in the fluid indicated a different meningial lesion. We were wont to consider the lesion as an inflammation of the meningies due to a bacterial invader and we left out of account what happened to the brain substance itself and the pole that this played in the evolution of the clinical picture. We have studied the cerebrospinal fluid and it was held that it was infected, as indeed it was, but in the fluid was really the washed off products of diseases located in the brain tissue and in the blood channels. Hence, the progress in which has marked most of the otological research has been inadequate in this field. Presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 19, 1934.

found in keeping the cerebro-spinal fluid circulating. Any procedure which stops the circulation of the cerebro-spinal fluid defeats the objective which is in view.

G Meningitis as it is clinically seen, presents itself in stages. Diagnostic data will vary according to the stage at which we first recognize the disease. Each of these stages is in itself somewhat of an entity which changes as the lesion evolves, and the clinical picture and laboratory data vary as these changes occur.

H Finally we should recognize that meningitis of otitic origin is as often a complication of acute purulent otitis media as it is the sequel of mastoiditis. We should differentiate those cases occurring during the course of an acute otitic infection from those following an acute mastoiditis. The time intervening between the mastoidal involvement and the first meningeal sign seems to have significance and the record of cases shows that the very poorest results are found in those in which mastoidectomy was necessary during the first week of middle ear infection. The cases which occur as sequelæ of middle ear chronicities are again to be comprehended as of different origin. Often they are the result of secondary infections of cholesteatoma or the result of spreads endocranially of unrelieved often unrecognized labyrinthine perilabyrinthine or petrosal pyramid infections. It becomes necessary to differentiate primary meningeal invasions from those which follow infections which are secondary to otitic invasion.

I The healed cases which are recorded in the literature give evidence that cures are obtainable in cases where the clinical picture is not stormy and the symptom complex can best be characterized as weak and where pressure signs predominate over the signs of toxicity—the Babinski is often absent or only very weakly present and signs of pyramidal tract involvement are not distinctly marked.

The findings in the cerebro-spinal fluid give the best indicator of the type of lesion present. The fluid shows the state of being of the brain tissue cells. It is a means of knowing and estimating the amount of intracranial pressure and through the study of its chemistry a knowledge is won of the tissue reactions the intensity of their activity and the type of bacterial invasion which the given case presents.

Its physical characteristics are deceptive. Clear fluid has been known to show bacterial content and a markedly turbid fluid has been shown to be bacteria free. In view of the importance of the findings obtained from the examination of cerebro-spinal fluid it is necessary to stress the fact that the fluid must be examined immediately after it is withdrawn. The same fluid examined again and again after intervening hours will give different findings.

This holds true for cytology as well as for the chemistry of the fluid. The anti bacterial properties inherent to cerebro-spinal fluid must be remembered and even the search for bacterial contents must be undertaken immediately after the fluid is obtained.

After an interval of time particularly in the early stages of the lesion, the fluid may be found sterile, whereas, had the examination been made at once, after lumbar puncture, it might have shown bacteria present.

According to most investigators the cerebro-spinal fluid is a dialysate. It filtrates from the capillaries of the choroid plexus and from the capillaries of the perineural and perivascular spaces of the central nervous system. Eventually it reaches the venous blood channels, being absorbed into the lateral and longitudinal sinuses of the skull. In the normal state the fluid is in osmotic equilibrium with the blood plasma, and its production and flow may be said to be influenced toward an exaggerated production or a retardation by the relative dilution or concentration of the blood.

Cerebro spinal fluid carries on a dual function. It is concerned with the metabolism of brain cells carrying away the effects of ketabolism and its other function is that of equalizing and maintaining intracranial pressure. Meningeal infection disturbs these normal functions. When the fluid cannot carry away the effects of ketabolism when a stasis in its circulation results, the cells are poisoned by the products of their own activity and there develop those clinical signs of toxicity and neural reactions which are noted in the clinical picture.

The index of this toxicity can be estimated by studying the choline content of the fluid. Ordinarily the fluid transudes through the capillaries of the choroid plexus in the face of intracranial pressure and this same pressure influences its absorption. The first effect of a bacterial invasion of the meninges is a great outpouring of fluid from capillary vessels. This is to be comprehended as a defense mechanism—an effort on the part of the body to cleanse itself of the invading pathogenic bacteria and the resultant tissue reactions. Clinically at this stage there is a demonstrable increase in intracranial spinal fluid pressure. To a great extent the interconnecting orifices between the various ventricles and the meshes of the pia are still open and a real exudate has not yet formed.

The general effect of this increased intracranial pressure is compression of the blood vessels. Both afferent and efferent vessels are involved and there results a lessened oxygenation of the parts and the formation of large quantities of lactic acid follows.

Lactic acid is also present in increased amounts in the blood plasma especially during fevers. Since the early stage of meningitis with which we are here dealing is always accompanied by fever, it becomes necessary to estimate the amount of lactic acid present in the patient's blood plasma at the same time that the spinal fluid estimation is made. Lactic acid has been found to be very much higher in the cerebro-spinal fluid than it is in the blood plasma, and it is possible to establish a ratio between the two findings. The lactic acid content of the meningeal spinal fluid is apt to be four times that of the lactic acid content of the blood plasma.



# MENINGITIS—THE RESULT OF DISEASE OF THE PETROUS APEX AND SPHENOIDAL BASIS<sup>1</sup>

WELLS P. EAGLETON, M.D., F.A.C.S., NEWARK, NEW JERSEY

**T**HE theory of the specificity of function of a tissue depending upon the embryonic anlage from which its cells evolve is of surgical value in an understanding of pyogenic lesions of the skull, as it furnishes an explanation for the variations in tissue reactions to infection of bones of unlike embryonic origin. Thus a pyogenic inflammation of a petrous apex or the sphenoidal basis (a) runs a distinctive course and (b) requires a different surgical viewpoint than infections of an adjacent cranial bone such as mastoiditis, nasal sinusitis, or osteomyelitis of the cranial vault.

Petro-apicitis is frequently an unrecognized cause of meningitis. In the vast majority of cases, it is a true osteomyelitis. Petro-apicitis represents a different pathological and surgical entity from the recognized forms of mastoiditis with which apical suppuration is usually but not invariably associated occurring as it does in a genetically different type of bone.

Infections within a petrous apex have a much greater tendency to spontaneous cure, i.e., without the opening of the infected area than have the associated mastoid suppuration because in apical suppuration the infection is influenced by the presence of red bone marrow.

*Clinical classification of infections of the petrous apex and sphenoidal basis.* I propose a clinical classification based on my experience with 42 cases of petro-apicitis and 24 cases of infection of the sphenoidal basis, as follows: (1) reactive and reparative osteitis; (2) non suppurative congestive cases—symptoms due to venous stasis; (3) chronic bone sepsis cases (without macroscopic pus); (4) abscess of apex—(a) without a tract (b) with a tract; (5) acute septicæmia cases associated with a continuous positive blood culture and meningitis.

*Intrameatal type of facial paralysis.* There occurs a specific type of facial paralysis in petro-apicitis which is seen in no other process. This "suspicion of a facial (an intrameatal type of facial paresis) is transient in duration and limited in extent. It is characterized by the partial non closure of the lower lid during sleep although the ability spontaneously to close the lid completely is not lost.

Meningitis from suppuration of the apex is at first limited to the cisterns (a) covering the floor of the middle fossa or (b) mesial to the internal auditory meatus of the posterior fossa.

*Infection of the sphenoidal basis.* The pattern of blood supply within the red bone marrow accounts for the unique reparative and specific protective properties of the sphenoidal basis also possessed, but to a lesser extent by the petrous apices. It also explains the rarity of small sequestra in pyogenic lesions of an apex or of the sphenoidal basis.

A symptomless infection of the sphenoidal basis is a frequent, but generally overlooked, cause of meningitis, especially of the pneumococcal type. In pneumococcus Type II meningitis, I have cured cases by simply draining the sphenoidal sinus and by the administration of serum.

*Control of infection by metaplastic reconversion from yellow (acellular) fat marrow into red (cellular) bone marrow.* During infancy and childhood, all the bones of the torso and extremities are filled with red cellular bone marrow containing no fat. However, none of the cranial bones, with the exception of the sphenoid, the occipital and the two petrous apices (which form the primordial basis of the skull) contain red bone marrow although the bones of the tympano-antral area of the nasal accessory cavities which increase in size by pneumatization are, at birth filled with yellow fat marrow. The red (cellular) marrow at osseous maturity subsequently, is converted into yellow acellular fat. This metamorphosis from red into yellow fat marrow occurs in all red marrow containing bones, with the exception of the sphenoid, the segmental portion of the occipital, the vertebrae, the ribs, and the os innominatum, whose spongy tissue has a preponderance of red cellular bone marrow throughout life.

However, if at any time an irritant, notably infection or cancer enters, or even indirectly affects a marrow containing bone, its yellow (acellular) fat marrow may become reconverted into red (cellular) marrow. This rapid metaplastic reconversion from yellow (acellular) fat marrow to its original state of red (cellular) bone marrow is, I believe, an evidence of the tissue mechanism which red marrow containing bones possess for the local control of infection.

*Metaplastic reconversion from pneumatic air filled spaces into the original bone marrow state within an apex accounts for the infrequency of apical abscess.* Primarily the petrous apex is a red (cellular) marrow containing bone, its red marrow being converted into fat or replaced by air filled cells early in life. It does not combat infection simply by pouring forth round polymorphonuclear cells brought to it by the circulation, as is the reaction of the mastoid to suppuration but on the approach of infection the pneumatic spaces within the apex may return to their original bone marrow state. Thus it may become the seat of a unique physiological metamorphosis to which attention has not been previously directed. This phenomenon I have observed in at least 2 cases as demonstrated at postmortem examination.

*Treatment of meningitis from apical or sphenoidal infection.* If we are to be successful in the treatment of meningitis we must abandon many of our preconceptions for in the past all surgical treatment has been based too much on the principle of drain

<sup>1</sup>Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 19, 1934.



age of the entire arachnoid circulation, which is impossible. In my opinion, operation on the meninges, if preceded by ligation of the common carotid artery, gives a higher percentage of recoveries than other-wise, because carotid ligation relieves venous congestion, which postmortem examinations show to be invariably present in all cases of meningitis. In the surgical treatment of meningitis, it is of paramount importance that the surgeon should early

## NON-OPERATIVE TREATMENT OF NASAL SINUS DISEASE

WILLIAM MITHOFFER, M.D., F.A.C.S., CINCINNATI, OHIO

THE treatment of chronic nasal sinus disease in a non operative manner is, in the majority of instances, an unsatisfactory procedure. We must, therefore, when attempting this method of treatment, select our cases with discretion, and not continue to treat for any length of time a patient who is in need of a more radical procedure. We shall eliminate immediately from our discussion the treatment of all very acute inflammatory processes of the nose and nasal accessory sinuses whether associated with fever or not. We believe that any local treatment at this time, unless it be the application of a vasoconstrictive agent, will only kindle the fire and be the cause of a reaction and a spread of the disease. The chief consideration will, therefore, be the subacute and chronic infections. How shall these patients be treated non surgically? In the first place, let it be said that no one fixed plan of treatment can be used in all cases. The various means and methods of treatment which we have employed in our practice are the following: systemic, treatment of the nasal mucosa, median rhinoscopy, treatment of nasal recesses, tampons, suction irrigation, dilatation of the ostia and nonsurgical duct, irrigation of the sinuses, and infra red and ultraviolet therapy. We may rightly say that the most difficult problem before the medical profession today is the study of the constitution of the patient, inasmuch as each individual reacts to certain irritants according to the character of his underlying qualities, and these qualities we term constitution. It is our belief that the treatment of the constitution of the patient with due hygienic measures of living, endocrine and intestinal changes is of greater importance than the detour of the type and virulence of the bacteria. To emphasize the bacterial aspect only and give vaccines, specific or non specific, is not sufficient. We must not forget that the constitutional elements of the patient had not been ready to receive them not have been present in the constitutional elements of the patient had not been ready to receive them. Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 19 to 1914

A patient in whom the constitutional elements are inadequate to combat infection readily acquires a chronic state of the nasal sinus mucosa following an acute infection. In these patients, two physiological functions are easily lost, namely, movement of the ciliated epithelium, and secretion of mucus—both very important functions when infection takes place. A patient whose sinuses are unable to perform their physiological function at the time of an infection is left with an exudate nasal mucous membrane which may cause retention in the recesses—a favorable condition for the establishment of chronicity. An acutely inflamed maxillary sinus should rarely, if ever, be irrigated in the presence of fever, because of the danger of causing a systemic infection following the lavage. Patients are usually able to combat the infection in an antrum, provided no other irritant appears upon the scene such as the irritation which may be caused by an antrum lavage. As soon as another insult is added to the infection already present in the antrum, an imbalance of the body mechanism takes place. The bacteria gain the upper hand and many times, because of the injury to the mucous membrane from puncture, a secondary inflammation ensues and a local or general sepsis may be the result.

In applying the various forms of treatment, both local and general, we must forget for the time being, at least, that we are rhinologists limited to a small specialized field. We must try to be real doctors who are making a special study of a very sensitive part of the body—the nose and its adnexa—areas which are affected very readily by a systemic dyscrasia.

A hasty surgical approach is, in our opinion, a great mistake. Surgery, in most instances, should be undertaken only after a careful analysis has been made, or should follow the conservative treatment after this has proved of no avail. When surgery is necessary, its success will depend on the ability of the surgeon to detect every affected sinus, and this

membrane

THE OPERATIVE TREATMENT OF NASAL SINUS DISEASE<sup>1</sup>

EDWARD C SEWALL M D, SAN FRANCISCO, CALIFORNIA

A DISCUSSION of the operative treatment of nasal sinus disease necessitates correlating various technical endeavors, some as yet unpublished, and evaluating methods and hoped for improvements in treatment with which I have been continuously occupied since the publication of my original article entitled "Fronto-Ethmoid Sphenoid Operation under Local Anesthesia," in the *Archives of Otolaryngology*, in 1926. I am inclined to quote as follows from that article because what was said then needs even more emphasis today.

**Indications for operation.** The operative treatment of sinus disease is a subject that I feel should be approached with considerable caution. I am proposing a rather radical line of procedure that I feel may add to our efficiency in handling certain cases. Still I do not wish to leave the impression that I am applying these measures except after careful study or when former unsuccessful operative work would seem to make their applicability advisable. I have gone into the question of diagnosis frankly but must make the point plain that the diagnosis arrived at does not condemn the patient to operative measures. It becomes a matter of the nicest judgment on the part of a well trained surgeon, probably with the invaluable assistance of the internist to determine whether the sinuses should be operated on. A rubric of the operative indications would only be about as useful as those that have been compiled to tell us when to operate on a chronic running ear. Many people with apparently excellent health are sufferers from infected sinuses. The hawking and spitting that is so commonly heard and the mucopurulent expectoration seen on our city pavements are evidence of the widespread distribution of sinus disease. While admitting that many people seemingly well are carriers of this infection it is obvious that they are apparently in good health in spite of the sinusitis. It is a menace constantly carried about and often proves to be the vulnerable heel of Achilles leading to the establishment of some important vital disorder. The inability to discover the true focus, the removal of the wrong focus or the incomplete treatment of the right focus have brought a certain amount of opprobrium on the focal infection theory. Incomplete treatment of the right focus is practiced so commonly in connection with sinus disease that the specialists must take the onus of the lack of understanding of the importance of sinus infection on the part of many of the medical profession. These men have conscientiously and repeatedly referred patients for elimination of nasal infection. Failure after nasal sinus operation to cure the disorder in which the internist was interested very frequently has been interpreted as indicating improper diagnosis. The use of the method I have advocated of gathering the nasal and post nasal discharge from the patient on pieces of cloth will show the internist himself whether the results he has asked for have been achieved.

Ordinarily, before operation on the sinuses is to be considered, all other factors that may be contributing to the trouble should be corrected. Climate has been given especial prominence. Whatever therapeutic measures have been found useful may be employed.

Constructive surgery, when indicated, including submucous resection, tonsillectomy and adenoidectomy, should be given precedence and followed by sufficient time for accomplishment of results before the destructive surgery of the sinuses is advocated.

In presenting my present operative plan, it may be said that the intricate technical developments have followed naturally upon the introduction of a bloodless technique. This was accomplished by ligation of the vessels supplying the operative field, under local anesthesia secured largely by blocking the nerves before or at their entrance into the field.

Sinus surgery may well be divided into a pre and a post ligation period. Prior to the introduction of these methods, general anesthesia was commonly used in external sinus technique.

The literature contains many descriptions of the bloody operative field where all nicety of technique was impossible.

The operative steps may be briefly summarized as follows:

1 The patient lies on the back, somnolent from the effects of sodium amylal, scopolamine and morphine.

2 Cocaine is applied topically in the nose.

3 Novocain is injected deep into the orbit to block the nasal branches of the fifth nerve supplying the operative field.

4 A small incision at the inner angle of the orbit suffices, and leaves practically no scar.

5 The frontal sinus and the ethmoids are entered through a window cut through the frontal and maxillary bones.

6 The ethmoid vessels are ligated in the orbit.

7 The frontal and ethmoid sinuses are thoroughly inspected and cleared of disease.

8 The sphenopalatine artery is tied, permitting the intricate sphenoid technique.

9 A posterior submucous resection allows the removal of the whole of the floors of both sphenoids.

10 Flaps prepared from nasal mucosa are used to line the operative fields and prevent the closure of the nasofrontal drainage opening.

11 The wound is closed at once with metal clips, no packing, no bandage whatever.

<sup>1</sup> Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 19, 1934.

# CANCER OF THE LARYNX, INTRINSIC, ITS SURGICAL CURE!

GABRIEL TUCKER, M.D., PHILADELPHIA, PENNSYLVANIA

state of perfected technique that makes the procedure harmless if it is properly done. The reason we have not been able to cure more cases of cancer of the larynx by surgery in the past lay not with us but with those general practitioners and otolaryngologists who were afraid of biopsy and refused to have tissue removed until the appearance was characteristic, and the lesion hopelessly late. Biopsy of a non cancerous growth in the larynx will not cause it to become cancer. Neither will biopsy propagate cancer in the larynx where it already exists if the proper course is followed. With the present technique, a histological diagnosis based on a fixed specimen of tissue may be obtained within 48 hours, and surgical treatment can be promptly carried out. The lymphatic drainage within the larynx is such that there is no probability of metastatic extension within this short period.

**Treatment.** "Early diagnosis is the pearl without price in the surgical cure of cancer of the larynx" (3). Laryngofissure and total laryngectomy are the surgical procedures of choice in the treatment of cancer of the larynx.

**Laryngofissure.** Cancer within the larynx, intrinsic, is the most favorable type for surgical treatment. If the cancer involves the anterior two thirds of the vocal cord—the most frequent site of origin—and has not extended beyond this, laryngofissure will cure over 85 per cent of the cases. If the growth involves the anterior commissure and both cords in the anterior portions, laryngofissure by a special technique for anterior commissure growths will result in cure in an equally high percentage of cases. Laryngofissure saves the patient's larynx as well as his life. A subperichondrial resection of the diseased area with a wide margin of normal tissue surrounding it is all that is required in properly selected cases of laryngeal cancer, because the peculiar lymphatic drainage in the anterior portion of the larynx prevents rapid extension of the disease. The procedure can be carried out under local anasthetics, and there should be no operative mortality. Following laryngofissure, the larynx must be kept under close observation for at least a year. If granulations appear at the site of excision of the growth, they should be removed by direct laryngoscopy and submitted to histological examination. If they should be recurrent, with a probable cure of 90 per cent of the laryngeal cancer.

**Laryngectomy.** Total laryngectomy should be done when there is more extensive involvement. Where the disease originates in the posterior portion of the larynx, or extends supraglottic, or involves the ventricular bands or the base of the epiglottis, total laryngectomy by direct laryngoscopy has reached a biopsy. The removal of tissue for histological examination of the laryngeal cancer, typical in appearance, which on biopsy showed both cancer and tuberculous (2).

The clinical incidence of cancer of the larynx is apparently much greater than the incidence indicated by the rate of deaths from laryngeal cancer. The rate of laryngeal cancer deaths is given as 0.8 per cent, deaths from cancer of the esophagus 1.5 per cent, and deaths from cancer of the lung as 2.1 per cent of all cancer deaths. In a bronchoscopic and treatment of diseases of the larynx, esophagus, and lungs there were seen during the same period 200 cases of cancer of the larynx, 220 cases of cancer of the esophagus and 57 cases of cancer of the lung. With the present perfection of methods of early diagnosis, resulting in the surgical cure of at least 80 per cent of the early cases, the percentage of deaths from cancer of the larynx can no longer be taken as the true rate of incidence of laryngeal cancer.

**Symptoms.** In the consecutive series above noted of 200 cases of laryngeal cancer (1) it was found that every patient manifested either chronic hoarseness or local discomfort or both chronic hoarseness and local discomfort early in the course of the disease. In this study there were 144 cases (72 per cent) which were apparently of intrinsic origin. Chronic hoarseness was an early symptom in every case, but in many cases when the patients were first seen the lesions were far advanced and presented one or more of the signs and symptoms of inoperable cancer, namely, dysphagia, aphonia, adenopathy. If the symptoms of chronic hoarseness and local discomfort were properly evaluated and routine diagnostic studies done in every case, cancer of the larynx would be found while the lesion was still early and curable by surgery.

Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, October 19, 1934

laryngectomy is required. In cases in which the under surface of the epiglottis only is involved, the epiglottis can be removed completely by a laryngofissure approach, the remainder of the larynx being preserved.

The surgical procedure selected for the individual case depends on two factors: (1) the location and extent of the lesion, (2) the grading of the cancer cells in the growth.

The location and extent of the lesion is determined by careful mirror examination, by X-ray examination of the neck and chest including the larynx and oesophagus, and by direct inspection of the larynx, pyriform sinuses and upper oesophagus before operation. After the larynx is opened the lesion also is carefully examined.

Cell grading is of greatest importance in determining the radiosensitivity of the cancer post operative irradiation may be of great value in radio-sensitive types of cancer. Pre operative irradiation is regarded as inadvisable by most laryngeal surgeons.

#### SUMMARY

1. The incidence of cancer of the larynx seems to be relatively greater than the rate of cancer deaths indicates. Because of the early diagnosis and the surgical cure of a large number of cases, the death

rate cannot be taken as a true indication of the incidence of laryngeal cancer.

2. Chronic hoarseness and local discomfort are always early symptoms in cancer of the larynx.

3. Biopsy, by direct laryngoscopy, should be the final diagnostic step in cancer of the larynx. Biopsy will not produce cancer, and where cancer exists and biopsy is done, if the proper routine is followed, surgical removal of the cancer can be carried out before metastasis can occur.

4. Surgical treatment, laryngofissure and laryngectomy, will cure practically all cases of intrinsic cancer of the larynx. Laryngofissure in properly selected cases will save the larynx as well as the patient's life. Educating the laity and the general practitioner to recognize that local discomfort and chronic hoarseness may mean cancer is the next most important step in the cure of cancer of the larynx.

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## PATHWAYS OF APPROACH TO THE PETROUS PYRAMID<sup>1</sup>

MARVIN F. JONES, M.D., NEW YORK, NEW YORK

IN studying surgical methods for the relief of petrositis it becomes necessary to focus attention on the intimate anatomical structure of the temporal bone. Pneumatized tracts are of major importance.

More attention has been attracted to the acute phases while the chronic stages with acute exacerbations are less widely recognized.

All operative procedures (with one exception) aim at the superior group of cells while the logical method of drainage would seem to be through dependent portions of the bone.

The symptomatology developed recently would seem to indicate the extent and location of pathological changes, thus facilitating an intelligent choice of surgical procedures.

Impaired hearing and labyrinthine symptoms plus location of pain are proposed as indicative symptoms.

A discussion of the surgical procedures already advocated, and the difficulties found by personal experience illustrate some of the pitfalls.

Histological sections, X-ray pictures, and gross dissections illustrate the statements embodied in the paper.

<sup>1</sup>Abstract of paper presented before the Section on Otolaryngology, Clinical Congress of the American College of Surgeons, Boston, October 19, 1934.

# COMMITTEE AND DEPARTMENT REPORTS

## DEPARTMENT OF CLINICAL RESEARCH—ALBERT J OCHSNER MEMORIAL

BOWMAN C CROWELL, M D, CHICAGO, ILLINOIS  
Associate Director American College of Surgeons Director of Clinical Research

THE work in clinical research which is being conducted by the College includes that of the following committees

Committee on the Treatment of Malignant Diseases  
Committee on the Archives of Malignant Diseases  
Committee on Bone Sarcomas  
Committee on Clinical Laboratories  
Committee on Fractures  
A survey of the work of this department which has been performed during the past year is embraced in the reports of the individual committees

## COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES

CHARLES A. DUKES, M D, OAKLAND, CALIFORNIA, Chairman

THIS Committee, founded in 1922, has made a consistent study of records and clinics with the hearty co operation of the surgeons, pathologists and radiologists, throughout the United States and Canada  
Standard uniform record forms have been designed adopted by cancer clinics, and hospitals where cancer clinics have not yet been formed In 1930 the standard for organization and conduct of cancer clinics was formulated by the Committee and adopted by the Board of Regents The wide acceptance of this standard of hospitals in the United States and Canada has been a pleasing result of the College activity and the figures indicating the growth of the movement will be presented at this meeting by the Director of Clinical Research  
The report of this Committee would not be complete without an acknowledgment of appreciation for the work of Dr Robert B Greenough, who has been Chairman from the beginning until this year The amount of time which he has spent and the skill which he has shown in completing the organization and in working through the maze of reports and forms which have been necessary to the completion

of this program I am sure will be appreciated by everyone, and there is considerable fear on my part that I shall be unable to live up to the high standards which his leadership has created  
It is also fitting that we should pay tribute to that great physician and surgeon who devoted so much of his life to this work—Dr Burton J Lee, whose passing to the Great Beyond occurred shortly after the 1933 meeting  
The personnel of the Committee on the Treatment of Malignant Diseases is as follows

Charles A Dukes, Oakland, Chairman  
Bowman C Crowell, Chicago, Secretary  
Frank E Adair, New York  
A C Broders, Rochester, Minn  
Curtis F Burnam, Baltimore  
George Crile, Cleveland  
Rupert H Fildes, St Louis  
John M T Finney, Baltimore  
Robert B Greenough, Boston  
Frank W Lynch, San Francisco  
Alton Ochsner, New Orleans  
Lugene F Pendergrass, Philadelphia  
Francis C Wood, New York

## STANDARDIZATION OF CLINICAL LABORATORIES

AT the meeting of the Committee on the Standardization of Clinical Laboratories, held in October, 1926, the following Minimum Standard for Laboratories was adopted and has been approved by the Board of Regents

1 That the clinical laboratory shall be under the direction of a graduate in medicine, especially trained in clinical pathology

2 That the clinical laboratory shall be prepared to perform satisfactory work in (a) histopathology, (b) bacteriology and parasitology (c) serology, (d) hematology and (e) chemical and morphologic examinations of other body fluids exudates, transudates and excreta

3 That all tissues removed at operation shall be

examined in the laboratory and reports rendered thereon

4 That an easily available copy of all reports shall be filed in the laboratory and one with the patient's record In histopathology there shall be in the laboratory a cross index of, at least, the name of the patient, of the hospital or laboratory number of the patient, and of the lesion or organ There shall be preserved also, for at least 3 years, either section embedded tissue, or gross tissue from each case from which tissue is removed

5 That a uniform system of charges for laboratory work shall be enforced.

6 That the clinical pathologist shall attend the monthly staff conferences of the hospital

## CANCER CLINICS APPROVED TO OCTOBER 1, 1934

IN 1930 the Board of Regents of the American College of Surgeons on the advice of its Committee on the Treatment of Malignant Diseases, announced its policy of emphasizing the necessity of making the benefits of contemporaneous knowledge of cancer available to each and every cancer patient in the country Already existing hospitals were recognized as the natural centers in which modern diagnostic and therapeutic procedure should be conducted, and a minimum standard was formulated for cancer clinics in such hospitals

Information concerning the cancer clinic movement of the College was published, and all approved hospitals of one hundred or more beds were urged seriously to consider cancer clinic organization Representatives of the College have visited the hospitals have consulted with members of their medical staffs and administrators, and have furnished to the College a summary of the activities of each hospital with regard to the diagnosis and treatment of cancer Ordinarily, these hospitals have the personnel and equipment for such service, but we believe that a definite organization for this special service is of advantage in obtaining the maximum of efficiency in the campaign against cancer

The College announces its second list of the hospitals conducting cancer clinics which conform to its minimum standard The conduct of such clinics varies somewhat according to the character of the hospital with regard to whether its patients are charity patients or otherwise Some institutions have established diagnostic clinics but refer the patients elsewhere with advice as to the nature of treatment that should be administered In certain other large institutions some departments have organized cancer clinics for the recognition and care of cancer in their patients while other departments have not so organized Cognizance of these facts is taken in the publication of the list of institutions that

are approved from the standpoint of their cancer clinics

It is further recognized that certain institutions have accepted the minimum requirements for cancer clinics as formulated by the American College of Surgeons and are endeavoring to carry them out, but for lack of time or other acceptable reasons have not yet been able to do so in every detail In the following list they are indicated as having 'provisional approval'

Total cancer clinics surveyed	239
Approved cancer clinics in general hospitals	97
Provisionally approved cancer clinics in general hospitals	55
Approved cancer diagnostic clinics	23
Hospitals with departments conducting approved cancer clinics	6
Total approved cancer clinics	181

The publication of the list of 181 approved cancer clinics in no way indicates that effective cancer treatment cannot be obtained elsewhere but serves to show that these institutions have formally organized for this purpose as part of a country wide campaign in behalf of the cancer patient

In addition to the list of approved cancer clinics the College has information concerning 58 others which for one reason or another are not yet ready for a rating by the College and still 80 other hospitals have definitely signed their contemplation of the formation of such clinics in the future

## MINIMUM STANDARD FOR CANCER CLINICS IN GENERAL HOSPITALS

1 Organization There shall be a definite organization of the service and it shall include an executive officer and representatives of all the departments of

the hospital which are concerned in the diagnosis and treatment of cancer. The services of a secretary and of a social service worker shall be available.

*2 Conference.* As an essential feature of the service there shall be regular conferences or consultations at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic who are concerned with the case.

*3 Patients.* Reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either voluntary or obligatory in accordance with the vote of the medical staff or of the governing board of the hospital.

*4 Equipment.* In addition to the diagnostic and therapeutic surgical equipment which is required in every approved general hospital there shall be available an apparatus for X-ray therapy of an efficiency which is generally agreed upon as adequate, and an amount of radium sufficient to insure effective treatment.

## HOSPITALS CONDUCTING APPROVED CANCER CLINICS

## UNITED STATES

## ARIZONA

PHOENIX.—St. Joseph's Hospital

## CALIFORNIA

LOS ANGELES.—California Hospital

HOLLYWOOD.—Clara Barton Memorial Hospital

OAKLAND.—Highland Hospital of Alameda County

PASADENA.—Pasadena Hospital

SAN DIEGO.—San Diego County General Hospital

SAN FRANCISCO.—University of California Hospital

SANTA BARBARA.—Santa Barbara Cottage Hospital

## COLORADO

DENVER.—St. Luke's Hospital

\*Colorado General Hospital

## CONNECTICUT

BALDWIN.—Bridgeport Hospital

HARTFORD.—Hartford Hospital

ST. FRANCIS.—St. Francis Hospital

NEW HAVEN.—New Haven Hospital

WATERBURY.—Waterbury Hospital

## DELAWARE

WILMINGTON.—Delaware Hospital

\*Wilmington General Hospital

## DISTRICT OF COLUMBIA

WASHINGTON.—Frederick's Hospital

Georgetown University Hospital

\*Providence Hospital

\*Triennially approved

## FLORIDA

MIAMI BEACH.—St. Francis Hospital

## GEORGIA

ATLANTA.—Albert Steiner Clinic

THOMASVILLE.—John D. Archbold Memorial Hospital

## ILLINOIS

CHICAGO.—Cook County Hospital

Mercy Hospital

\*Michael Reese Hospital

St. Luke's Hospital

University of Chicago

HIVES.—Veterans' Administration Hospital

## KANSAS

KANSAS CITY.—Bell Memorial Hospital

## LOUISIANA

NEW ORLEANS.—State of Louisiana Charity Hospital

SHREVEPORT.—Shreveport Charity Hospital

## MAINE

PORTLAND.—Vaine General Hospital

## MARYLAND

BALTIMORE.—Howard A. Kelly Hospital

University Hospital of the University of Maryland

## MASSACHUSETTS

BOSTON.—Beth Israel Hospital

Collis P. Huntington Memorial Hospital

Massachusetts General Hospital

Palmer Memorial

Peter Bent Brigham Hospital

*5 Records.* In addition to the records which are required in every approved general hospital, there shall be additional records of (a) the details of the history and of the examination for cancer in different regions of the body, such as are indicated on the form records which are recommended by the Committee on the Treatment of Malignant Diseases, American College of Surgeons, (b) the details of the treatment by radium or X-ray as indicated on the form records of Malignant Diseases, of the American College of Surgeons, (c) periodic examinations at intervals for a period of at least five years following treatment.

*6 Treatment.* The treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic, except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise.

## STANDARDIZATION OF CLINICAL LABORATORIES

AT the meeting of the Committee on the Standardization of Clinical Laboratories, held in October, 1926 the following Minimum Standard for Laboratories was adopted and has been approved by the Board of Regents

- 1 That the clinical laboratory shall be under the direction of a graduate in medicine especially trained in clinical pathology
- 2 That the clinical laboratory shall be prepared to perform satisfactory work in (a) histopathology, (b) bacteriology and parasitology (c) serology, (d) hamatology, and (e) chemical and morphologic examinations of other body fluids exudates transudates and excreta
- 3 That all tissues removed at operation shall be

examined in the laboratory and reports rendered thereon

4 That an easily available copy of all reports shall be filed in the laboratory and one with the patient's record In histopathology there shall be in the laboratory a cross index of, at least, the name of the patient, of the hospital or laboratory number of the patient, and of the lesion or organ There shall be preserved also, for at least 3 years, either section, embedded tissue or gross tissue from each case from which tissue is removed

5 That a uniform system of charges for laboratory work shall be enforced

6 That the clinical pathologist shall attend the monthly staff conferences of the hospital

## CANCER CLINICS APPROVED TO OCTOBER 1, 1934

IN 1930 the Board of Regents of the American College of Surgeons on the advice of its Committee on the Treatment of Malignant Diseases announced its policy of emphasizing the necessity of making the benefits of contemporaneous knowledge of cancer available to each and every cancer patient in the country Already existing hospitals were recognized as the natural centers in which modern diagnostic and therapeutic procedure should be conducted and a minimum standard was formulated for cancer clinics in such hospitals

Information concerning the cancer clinic movement of the College was published, and all approved hospitals of one hundred or more beds were urged seriously to consider cancer clinic organization Representatives of the College have visited the hospitals and have consulted with members of their medical staffs and administrators and have furnished to the College a summary of the activities of each hospital with regard to the diagnosis and treatment of cancer Ordinarily these hospitals have the personnel and equipment for such service, but we believe that a definite organization for this special service is of advantage in obtaining the maximum of efficiency in the campaign against cancer

The College announces its second list of the hospitals conducting cancer clinics which conform to its minimum standard The conduct of such clinics varies somewhat according to the character of the hospital with regard to whether its patients are charity patients or otherwise Some institutions have established diagnostic clinics but refer the patients elsewhere with advice as to the nature of treatment that should be administered In certain other large institutions some departments have organized cancer clinics for the recognition and care of cancer in their patients while other departments have not so organized Cognizance of these facts is taken in the publication of the list of institutions that

are approved from the standpoint of their cancer clinics

It is further recognized that certain institutions have accepted the minimum requirements for cancer clinics as formulated by the American College of Surgeons and are endeavoring to carry them out, but for lack of time or other acceptable reasons have not yet been able to do so in every detail In the following list they are indicated as having "provisional approval"

Total cancer clinics surveyed	239
Approved cancer clinics in general hospitals	97
Provisionally approved cancer clinics in general hospitals	55
Approved cancer diagnostic clinics	23
Hospitals with departments conducting approved cancer clinics	6
Total approved cancer clinics	181

The publication of the list of 181 approved cancer clinics in no way indicates that effective cancer treatment cannot be obtained elsewhere but serves to show that these institutions have formally organized for this purpose as part of a country wide campaign in behalf of the cancer patient

In addition to the list of approved cancer clinics the College has information concerning 53 others which for one reason or another are not yet ready for a rating by the College, and still 80 other hospitals have definitely signified their contemplation of the formation of such clinics in the future

## MINIMUM STANDARD FOR CANCER CLINICS IN GENERAL HOSPITALS

1 Organization There shall be a definite organization of the service and it shall include an executive officer and representatives of all the departments of



NOVA SCOTIA	HALIFAX—Victoria General Hospital
ONTARIO	KINGSTON—Kingsion General Hospital
	LONDON—Victoria Hospital
	OTTAWA—Ottawa Civic Hospital
	TORONTO—Toronto General Hospital
QUEBEC	MONTREAL—Hopital Saint Luc
	INSTITUT DU KADUM
SASNAICHEWAN	MONTREAL General Hospital
	REGINA—Regina General Ho pital
SASARATON—City Hospital	
CHINA	PEKING—Peiping Union Medical College Hospital
	PEKING—Peiping Union Medical College Hospital
WEST VIRGINIA	CHARLESTON—Mountain State Hospital
WISCONSIN	MADISON—State of Wisconsin General Hospital
	MILWAUKEE—Columbia Hospital
CANADA	ALBERTA
	EDMONTON—University of Alberta Hospital
MANITOBA	ST BONIFACE—St Boniface Hospital
	WINNIPEG—Winnipeg General Hospital
NEW BRUNSWICK	SAINT JOHN—Saint John General Hospital

## HOSPITALS CONDUCTING APPROVED CANCER DIAGNOSTIC CLINICS

ARIZONA	TUCSON—St Mary's Hospital and Sanatorium
CALIFORNIA	SAN FRANCISCO—Mary's Help Hospital
ILLINOIS	CHICAGO—Northwestern University
MASSACHUSETTS	BOSTON—Boston Dispensary
	LAWRENCE—Lawrence General Hospital
	LOWELL—Lowell General Hospital
	LYNN—Lynn Hospital
MICHIGAN	DETROIT—St Mary's Hospital
MISSOURI	FULTON—Fulton State Ho pital
NEW HAMPSHIRE	HAVER—Mary Hitchcock Memorial Hospital

## HOSPITALS IN WHICH DEPARTMENTS ARE CONDUCTING APPROVED CANCER CLINICS

TENNESSEE	NASHVILLE—Vanderbilt University Hospital
CANADA	QUEBEC
	MONTREAL—Royal Victoria Hospital
MICHIGAN	DETROIT—Henry Ford Hospital
NEW YORK	NEW YORK—Presbyterian Hospital in the City of New York
	ROOSEVELT Hospital
OHIO	CLEVELAND—Lakeside Hospital

## REGISTRY OF BONE SARCOMA

BOWMAN C CROWELL M D CHICAGO ILLINOIS, Registrar

THERE have been 197 cases submitted to the Registry during the past year. Of these 161 cases have been registered.

Of 527 of the cases which have been circulated during the year, opinions have been rendered by 33 doctors.

The total number of cases in the Registry is now 1,705 classified as follows:

Osteogenic sarcoma	773
Ewing's sarcoma	171
Myeloma	73
Lymphosarcoma	8
Inflammation	89
Periosteal fibrosarcoma	27
Metastatic tumor	46
Angioma	13
Hæmangio endothelioma	14
Benign giant cell tumor	313
Giant cell tumor, malignant	18
Benign osteogenic tumor	58
Unclassified and miscellaneous	70
Not bone tumors	21
Paraosteal osteogenic sarcoma	4
Liposarcoma	4
Xanthoma	1
Parosteal Fibrolipoma	2
	1,705

There are 504 cases of osteogenic sarcoma that were treated 5 years or more ago, and 126 cases of Ewing's sarcoma that were treated 5 years or more ago.

In March 1926, Dr Ernest Amory Codman the originator and first Chairman of the Registry of Bone Sarcoma published 25 criteria for establishing the diagnosis of osteogenic sarcoma and 13 registered cases of 5 year cures analyzed according to these criteria.

From time to time since then the Registrar has announced an increasing number of such 5 year cures that have been registered. The present report presents 74 cases of osteogenic sarcoma and 10 cases of Ewing's sarcoma that have lived clinically free from the disease for periods of 5 years or more following treatment.

Three of the original 13 cases reported by Dr Codman died, B S R No 100 died 11 years after treatment with metastases in the spine, ribs and lungs after having been clinically free of the disease for 10 years or more, B S R No 50 died of paralysis 24 years and 9 months after treatment. B S R No 29 died from cancer of the breast 17 years and 5 months after treatment. The other 10 original 'cures' are still alive and free from the disease at the time of the latest report.

Five of the other cases here reported have died after the expiration of the 5 year period, B S R

No 1437 from cardiac and cerebral sclerosis, B S R No 176 following a prostatectomy, B S R No 910 with probable pulmonary metastases 8 years after treatment, B S R No 156, 9 years after treatment from heart disease without recurrence of the tumor, and B S R No 1025 from metastases.

At least 2 cases (B S R Nos 183 and 267) have had definite evidence of metastases which have disappeared after treatment.

Seventy one of the 74 five year cures of osteogenic sarcoma were treated by surgical methods, and of these 39 had surgical methods only. In the other 35 cases surgery was supplemented by radium or X ray treatment or Coley toxins or some combination of these agents. In 16 of the cases Coley toxins were administered.

The cases in which amputation was not performed are as follows:

B S R No 668 Local excision of tumor of lower part of femur followed by radium.

B S R No 183 Local excision of tumor of lower part of tibia followed by radium and Coley toxins.

B S R No 523 Excision of tumor of ilium followed by radium.

B S R No 585 Tumor of ilium treated by X rays only.

B S R No 109 Tumor of rib treated by resection followed by radium.

B S R No 373 Tumor of rib was explored and then treated by radium and Coley toxins.

B S R No 759 Tumor of scapula treated by excision and X rays.

B S R No 867 Tumor of scapula treated by excision alone.

B S R No 1523 Tumor of humerus treated by excision alone.

It is interesting to note that 20 of the cases had some form of operative procedure on the tumor at periods of 1 day to 5 years prior to amputation. These operative procedures consisted of single or multiple biopsies, curettages, explorations, excisions or resections.

There are in the Registry 504 cases of osteogenic sarcoma that were treated 5 years or more ago. No figures are included in this report to show the percentage of cures for the reason that this series does not represent a consecutive series of cases treated, and moreover there is a tendency for doctors to pay more attention to the registration of their unusually successful cases than to a registration of all of their cases.

## EWING'S SARCOMA

Ten of the registered cases of Ewing's sarcoma have lived from 5 to 21 years following treatment. These cases occurred in a group of 126 registered cases of this disease.

## COMMITTEE ON FRACTURES

FREDERIC W. BANCROFT, M.D., New York, Chairman

Edwin I. Bartlett, San Francisco  
 Everett L. Bishop, Atlanta  
 Joseph C. Bloodgood, Baltimore  
 Berney Brooks, Nashville  
 Ernest A. Codman, Boston  
 Charles L. Connor, San Francisco  
 James C. Loring, New York  
 W. R. Gable, St. Louis  
 Frank W. Hartman, Detroit  
 Henry W. Maynard, Rochester, Minn.  
 John J. Morton, Rochester, N. Y.  
 Channing C. Simmons, Boston

All 10 cases were subjected to surgery. In 7 of them amputation was performed. In the other 3 there were excisions. Six of the 7 amputated cases also received Colley toxins and, of these, 5 had radiation in one form or another. Four of the 7 amputated cases had one or more surgical procedures at some period prior to the amputation.

The personnel of the Committee is as follows:

Dallas B. Phemister, Chicago, Chairman  
 Bowman C. Crowell, Chicago, Registrar

THE purpose of the Committee on Fractures is to stimulate interest in and improve the treatment of fractures. The Committee functions through three main channels, first the Annual Meeting of the American College of Surgeons, second, the Annual Meeting of the General Committee on Fractures, third, Regional Groups. At the Annual Meeting of the American College of Surgeons the Committee arranges for the presentation of papers and the discussion of practical demonstrations in recognized methods of fracture treatment and holds a clinical conference with members of the various regional groups. The Committee meets in January of each year. The first day is given over to clinics wherein advances in the treatment of fractures are shown and the second day is devoted to reports of the various subcommittees. The subcommittees are as follows: (a) Scientific—presenting the latest advances in research or treatment, (b) Educational—both undergraduate and postgraduate, (c) Regional groups, (d) Physical therapy, (e) Bone plates and screws, (f) American Railway Surgeons, (g) Editorial, (h) Transportation and ambulance equipment. The Committee has concentrated its efforts during the past year on two main subjects: (1) the immediate application of traction at the site of injury, following the dictum "spint them where they lie," (2) the early reduction and improved treatment after the patient arrives at a hospital. The application of immediate traction to long bone fractures has been more and more emphasized as high speed locomotion by automobiles and airplanes has increased the number of serious injuries improper or no splinting during transportation not only delay the healing time of the fracture but also may cause serious shock, hemorrhage or death. Men experienced in the treatment of fractures are convinced that reduction before edema and swelling results in better replacement of fragments and hence diminished time of disability, and better function when union has occurred. Because of a limited time at my disposal, I shall report only on first, the activities of the Committee.

Many police and fire emergency squads have been trained and are using the method as a routine, also some mines and industrial plants which have their own first aid crews.

An important new contact, largely through the efforts of Dr. Thomson, of Lincoln, Nebraska, has been made with the National Council of the Boy Scouts of America. Dr. Owen and Dr. Scudder have been of great assistance in this. Mr. Fred C. Mills, National Director of Health and Safety Service, is enthusiastic in his efforts to educate his personnel in fixed traction. At their annual meeting in June,

this field again. The major portion of transportation of the injured in this country is done by the undertakers. One of their national organizations sent out a questionnaire on this subject, prepared by the subcommittee, to its entire membership. Replies were received from about 70 per cent. Of these about 70 per cent were in favor of adopting fixed traction for use on their ambulances and said they were ready to do so if they could be trained. The other large national organization of funeral directors is considering adoption of the method though its Committee on Education

business improves they expect to enter actively into work has been held largely in abeyance. As soon as ways. On account of the economic depression this procedure for establishing first aid posts on the high the Red Cross to all chapter chairmen outlining a pamphlet was sent out by this method. In 1930 a pamphlet was sent out to each half all instructors will have been prepared to teach instructors and it is expected that within a year and a continued actively before groups of approved Red Cross states. Instruction in this method is being continued actively before groups of approved Red Cross states. Instruction in this method is being continued actively before groups of approved Red Cross states. Instruction in this method is being continued actively before groups of approved Red Cross states.

1934, a demonstration of the application of the Thomas splint was given before the heads of their professional staff. About 30 men were present from all parts of the country. At Mendham, New Jersey, they maintain national training headquarters for professional scout leaders. They are key men whose duty it is to teach the scout masters throughout the country. At the last two schools demonstration of fixed traction has been given to about 50 men. Mr. Mills personally has given demonstrations to 4 group meetings of scout masters in New York, New Jersey, Ohio and Minnesota.

Before the Boy Scout Camps opened in the summer of 1934 a bulletin was sent from their National Headquarters asking all Scout executives to buy or borrow and place in their camps, a set of Thomas splints. There are about 500 of these camps in the United States. Dr. Thomson has prepared a description of the application of fixed traction illustrated with excellent photographs of Boy Scouts carrying out the procedure. The Boy Scouts is an organization of about 650,000 boys, 200,000 men, and 30,000 training instructors. We believe that this contact is one of the most important we have made in that it will be a constant means of educating the general public to demand of the medical profession proper fracture transportation. The National Organization of the Boy Scouts has agreed to do its utmost to further our campaign.

2 *Editorial committee.* The fracture manual was originally sent out in 15,000 pamphlets and has had since that time two printings in a revised form, 3,000 in the first and 2,000 in the second edition. Of these the greater number were distributed in the United States but in addition they were distributed in 20 countries outside the United States and Canada. The Professor of Surgery in the University of Australia asked for the privilege of incorporating The Outline in a pamphlet which he would issue to the students.

3 *Regional groups.* The regional groups function through clinical meetings in hospitals, executive meetings and travel trips to various clinics. In Boston the regional group has done a great deal to stimulate education throughout the greater part of New England and to improve the treatment of fractures in the various hospitals in Boston. In New York, through the efforts of the local group, the commissioner of hospitals ordered that Thomas splints for leg and Murray Jones splints for arm fractures be made a part of the equipment of every ambulance caring for city patients. Through the efforts of this group courses of instruction in fracture treatment for internes have been started in many of the municipal hospitals. In Philadelphia the regional group has instructed firemen, hospital internes and Boy Scouts in immediate traction and has obtained the necessary equipment for their ambulances. In Chicago the group gave excellent clinical demonstrations at the last meeting of the American College of Surgeons. The University of Chicago has taken over the Provident Hospital, a hospital for colored patients in

Chicago as a graduate school for negro physicians. Through the efforts of the local group fracture treatment has been emphasized and they are making Thomas splints in their own shops at a cost of one dollar. From all over the state negro physicians are coming for postgraduate instruction. In Arizona the state group has instructed the state police so that the main highways are being supplied with splints and immediate traction is being initiated in injuries occurring along the state highways.

This, in brief, is a summary of the Committee's most important activities.

Dr. Darrach estimated a saving of \$100 per patient by the use of proper transportation of a fracture. It has been estimated that there are about 300,000 extremity fractures a year in this country. By the adoption of this method it would seem that there would be an economic saving of \$30,000,000 a year.

If we are to reduce the marked economic loss that is sustained by the average person with fractures of the extremities there must be a nation wide campaign of medical education on the subject of fracture treatment. It has been said by Hitzrot that the average length of time that patients with fractures of the femur are kept from their normal occupation is about 14 months. This is by far too long a time. In order to improve fracture treatment public education must be carried on so that eventually we shall have stations along all highways and in main industries, where Thomas splints can be obtained readily. Groups of men must be trained in the application of these splints in a manner similar to that carried out during the war when large numbers of doughboys and stretcher bearers were instructed in the application of immediate traction. The Thomas splint must be cheap enough and light enough so that it can be returned by parcel post to its original station or to a central warehouse.

These problems are vital to all of us. More regional groups should be organized and we need aid and advice in the formation of these groups.

#### STANDARD FOR MINIMUM EQUIPMENT FOR FRACTURE TREATMENT IN HOSPITALS

1 That all general hospitals be equipped to care for fractures that the minimum equipment for the transportation and emergency treatment of fractures be the following or its equivalent.

Thomas upper extremity splints. Thomas lower extremity splints with traction straps slings and buckle straps. Hodgen splints coaptation splints assorted sizes, Cabot wire splints straight pieces of wood (of assorted length, width and thickness) for splints, plaster of paris bandages some form of overhead frame for suspension suitable x-ray apparatus including a portable machine if practicable.

2 That it is highly desirable that one individual surgeon be responsible for the supervision of the care of fractures in each hospital service.

3 That special record sheets be used for fracture cases.

4 That a close follow-up be maintained on all fracture cases for such time as necessary to establish an accurate knowledge of end results  
 The personnel of the Committee on Fractures is as follows

Frederic W. Bancroft, New York, Chairman  
 Robert H. Kennedy, New York, Secretary  
 Peter A. Bendixsen, Danversport  
 Willis C. Campbell, Memphis  
 Isadore Cohn, New Orleans  
 H. Earle Conwell, Birmingham  
 Salvador Cordoba, Venezuela  
 Fredenc J. Cotton, Boston  
 William R. Cubbins, Chicago  
 William Darrach, New York  
 Frank D. Dickson, Kansas City, Mo  
 Eldridge L. Eliason, Philadelphia  
 William L. Estes, Jr., Bethlehem  
 W. Edward Galtie, Toronto  
 Fraser B. Gurd, Montreal  
 Donald Guilme, Sayre  
 George W. Hawley, Bridgeport  
 Melvin Henderson, Rochester, Minn

William L. Keller, Washington  
 Norman T. Kirk, Washington  
 Philip H. Krenschen, Chicago  
 Samuel L. Ledbetter, Jr., Birmingham  
 Walter L. Lee, Philadelphia  
 George A. Leland, Jr., Boston  
 Paul B. Magnuson, Chicago  
 Henry C. Marble, Boston  
 Clay Ray Murray, New York  
 Lloyd Noland, Birmingham  
 Hubley R. Owen, Philadelphia  
 Edwin W. Ryerson, Chicago  
 Charles L. Scudder, Boston  
 W. O'Neill Sherman, Pittsburgh  
 Ernst A. Sommer, Portland  
 Kellogg Speed, Chicago  
 Frederic J. Tees, Montreal  
 Jorge del Toro, Porto Rico  
 J. Hubert Wagner, Pittsburgh  
 John B. Walker, New York  
 Roscoe C. Webb, Minneapolis  
 George L. Wilson, Toronto  
 John C. Wilson, Los Angeles  
 Philip D. Wilson, New York

## MEDICAL SERVICE BOARD

ROBERT B GREENOUGH M D F A C S, Boston, Chairman

THE Medical Service Board was authorized by the Executive Committee of the Board of Regents of the American College of Surgeons on July 15, 1933 and approved by the Board of Regents at the ensuing annual meeting. The Board was created for the purpose of formulating the general principles which could be established by the College for the guidance of its Fellows in relation to the many different projects for periodic prepayment plans for hospital and medical service for contract medical service and for industrial and traumatic surgical services all over the country. A statement of such general principles was submitted by the Medical Service Board to the Board of Regents on June 10, 1934 and approved by them. This report was published in the June 1934 Bulletin of the College.

The inaugural address of the President of the Col-

lege at the Clinical Congress held in Boston in October, 1934, dealt with this general subject.

Further reports of the Medical Service Board will appear in the quarterly Bulletins of the College, in the official Journal—SURGERY, GYNECOLOGY AND OBSTETRICS, and in other channels of information.

The personnel of the Medical Service Board is as follows:

Robert B Greenough Boston Chairman  
Bowman C Crowell, Chicago Secretary  
G Harvey Agnew Toronto  
Charles A Dukes Oakland  
Franklin H Martin Chicago  
C Jeff Miller New Orleans  
Eugene H Pool New York  
Arthur M Shipley Baltimore  
J Bentley Squier New York  
S Marx White, Minneapolis

## BOARD ON INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FREDERIC A BESLEY M D WAUKEGAN ILLINOIS Chairman

IN submitting this report of the activities and accomplishments of the Board on Industrial Medicine and Traumatic Surgery, may we say that it is believed that there is a growing interest in this branch of the educational program of the College on the part of leading industrialists. Dr Newquist and Dr Williamson are carrying on the survey of the industrial medical organizations with some very satisfactory results. They have surveyed 1122 such medical organizations in industry and approximately 55 per cent of them have been listed for approval. It is gratifying to note the psychological force of the desire of the leaders in industry to receive the stamp of approval of the American College of Surgeons. Obviously this fact is an important and essential factor in our educational program to secure better medical and surgical service and supervision for the army of workers in industry.

The report of Dr Newquist, "Medical Service in Industry and Workmen's Compensation Laws" has attracted a great deal of attention and favorable comment. In this connection it may be stated that the National Council of Compensation Insurance Companies extended an invitation to Dr Martin and myself to meet with them in a conference at New York in September for the purpose of discussing mutual problems. Dr Frederic Cotton attended this meeting with us. This Council represents both stock and mutual companies. As a result of this meeting a

committee was appointed by the Insurance Council to confer with the representatives of the College for the purpose of securing a better quality of surgical service for those injured in industry. It is believed that this movement has far reaching potentialities for achievements in this branch of our work.

Last year the Conference on Industrial Medicine and Traumatic Surgery held at the annual meeting in Chicago was very well attended and elicited a great deal of interest. We have stressed the purely scientific side of the subjects for the program for this year's meeting believing that this policy promotes the largest educational accomplishments. The sectional meetings held during the past year were favored by a very large attendance. A considerable portion of the programs were devoted to a discussion of medicine and surgery in industry, and we were rewarded by an increasing amount of interest in this subject. This is particularly true of the community health meetings where the audiences ranged in number from 2,000 to 12,000 in each city. The value of this spread of knowledge to the laity cannot be overstated. Naturally, the rumors that are being circulated of what the federal government may do in connection with the relief work as it concerns medical surgical and hospital service for the groups of lower financial incomes are most interesting, but any conclusions at this time must be purely speculative and would not aid us in the formulation of our

## COMMITTEE AND DEPARTMENT REPORTS

estimated period of disability, end result, as well as other information pertinent to the case or required for state for Workmen's Compensation claims or other purposes

4 Patients requiring hospitalization shall be sent to the American College of Surgeons

5 The medical department or service shall have general supervision over the sanitation of the plant and the health of all employees

The personnel of our Board on Industrial Medicine and Traumatic Surgery is as follows

Frederic A. Besley, Wakegan, Chairman  
 Bowman C. Crowell, Chicago, Secretary  
 John E. Bacon, Miami, Arizona  
 Bruce D. Campbell, Detroit  
 Frederic J. Cotton, Boston  
 Samuel R. Cunningham, Oklahoma City  
 George H. Gehrmann, Wilmington  
 Donald Guhrin, Sayre  
 Philip H. Krenschner, Chicago  
 A. D. Lazenby, Baltimore  
 Carey P. McCord, Cincinnati  
 John R. Nilsson, Omaha  
 Thomas G. Orr, Kansas City  
 W. O'Neill Sherman, Pittsburgh  
 Loyd A. Shoudy, Bethlehem  
 Ernst A. Sommer, Portland, Oregon  
 George W. Swift, Seattle  
 Frederick J. Teer, Montreal  
 John B. Walker, New York  
 S. Marx White, Minneapolis

## LIST OF APPROVED MEDICAL SERVICES IN INDUSTRY

WOODWARD  
 Woodward Iron Company  
 ARIZONA  
 INSPIRATION  
 Inspiration Consolidated Copper Company  
 MIA  
 Miami Copper Company  
 CALIFORNIA  
 CALOCERT  
 California and Hawaiian Sugar Refining Corporation, Limited  
 CLYDE CITY  
 \*Metcalf-Goldwyn Mayer Corporation  
 EMERYVILLE  
 Paraffine Companies, Inc. The  
 LONG BEACH  
 \*Ford Motor Company  
 LOS ANGELES  
 \*Firestone Tire & Rubber Company of California  
 \*Fox Film Corporation  
 General Petroleum Corporation of California  
 Goodyear Tire & Rubber Company  
 Pacific Electric Railway Company  
 Pacific Goodrich Rubber Company  
 Paramount Productions, Inc.  
 R. K. O. Studios, Inc.  
 Southern Pacific Company  
 Standard Oil Company of California  
 United Artists Studio Corp., Ltd.

## ALABAMA

ALABAMA POWER COMPANY  
 \*American Cast Iron Pipe Co  
 \*Lockham Pipe & Fittings Company  
 Tennessee Coal Iron and Railroad Company  
 GANSEY  
 Goodyear Tire & Rubber Co of Alabama  
 \*Gulf States Steel Company  
 MONTGOMERY  
 Alabama Dry Dock and Shipbuilding Co  
 Southern Kraft Corporation  
 \*Todd Shipbuilding & Dry Dock Co, Inc.  
 Provisionally approved

The second list of approved medical services in industry follows. This approval is granted on the basis of compliance with the Aluminum Standard for Medical Service in Industry as formulated by the American College of Surgeons. There are other in the requirements of this Aluminum Standard but of which time has not yet permitted a survey. The asterisk (\*) indicates Provisional Approval or that the medical services so designated have accepted the minimum requirements of the College standard and are endeavoring to carry them out, but for lack of time or other acceptable reasons have not been able to do so in every detail.

1 The industrial establishment shall have an organized medical department or service with competent medical staff including consultants and also shall have adequate emergency, dispensary and hospital facilities and personnel to assure efficient care of the ill and injured

2 Membership on the medical staff shall be restricted to physicians and surgeons who are (a) graduates from an acceptable medical school, with the degree of Doctor of Medicine, in good standing and licensed to practice in their respective states or provinces, (b) competent in the field of industrial medicine and traumatic surgery, (c) worthy in character and in matters of professional ethics, in the latter connection the practice of the division of fees, under any guise whatsoever, shall be prohibited

3 There shall be a system of accurate and complete records filed in an accessible manner, such records to include particularly a report of injury or illness, description of physical findings, treatment,

## MINIMUM STANDARD

It is believed that many industrial diseases, as exemplified by silicosis, will be covered by new compensation laws comparable to those prevailing in regard to trauma. Dr Martin is contemplating further changes in the personnel of your Board on Industrial Medicine and Traumatic Surgery so as to make it a more efficient working unit. We appreciate the splendid support that Dr Martin, the Fellows, and this Board have given us

## OAKLAND

Fisher Body Oakland Division, General Motors Corporation  
 \*Montgomery Ward & Co

## SAN BERNARDINO

Atchison Topeka and Santa Fe Railway System The

## SAN FRANCISCO

\*Emporium, The  
 Market Street Railway Company  
 Pacific Telephone and Telegraph Company The  
 Southern Pacific Company  
 Standard Oil Company of California

## SANTA MONICA

Douglas Aircraft Company Inc

## UNIVERSAL CITY

\*Universal Pictures Corporation

## COLORADO

## DENVER

Colorado & Southern Railway Company The  
 Denver and Rio Grande Western Railroad Company, The  
 Denver Tramway Company The  
 \*Ford Motor Company  
 Gates Rubber Co  
 Public Service Company of Colorado  
 Union Pacific System

## PUEBLO

Colorado Fuel & Iron Co The

## CONNECTICUT

## BRIDGEPORT

\*Bassick Company The  
 Bridgeport Brass Company  
 General Electric Company  
 Remington Arms Company Inc  
 Singer Manufacturing Co The  
 Stanley Works The  
 American Tube & Stamping Plant

## BRISTOL

New Departure Manufacturing Co The

## HARTFORD

Colt's Patent Fire Arms Manufacturing Co  
 Travelers Insurance Company The

## NEW BRITAIN

Stanley Works The

## NEW HAVEN

\*National Folding Box Company  
 Sargent & Company  
 Seamless Rubber Co The  
 Winchester Repeating Arms Company

## SOUTH MANCHESTER

Cheney Brothers

## SOUTH NORWALK

\*Hat Corporation of America

## STAMFORD

Yale & Towne Manufacturing Company The

## THOMPSONVILLE

Bigelow Sanford Carpet Co Inc

## WATERBURY

American Brass Company The  
 Chase Companies Incorporated  
 Scovill Manufacturing Company

## DELAWARE

## WILMINGTON

duPont E I de Nemours & Company

## DISTRICT OF COLUMBIA

## WASHINGTON

\*Capital Transit Company  
 Chesapeake and Potomac Telephone Companies, The  
 \*Hecht Co, The  
 \*Kann S, Sons Co  
 \*Lansburgh & Bro  
 Navy Yard  
 \*Potomac Electric Power Company  
 Washington Gas Light Company  
 \*Woodward & Lothrop

## FLORIDA

## JACKSONVILLE

Ford Motor Company

## TAMPA

\*Dixie Packing Corporation

## GEORGIA

## ATLANTA

Chevrolet Motor Company  
 \*Exposition Cotton Mills

## GAINESVILLE

Chicopee Manufacturing Corporation of Georgia

## ILLINOIS

## CHICAGO

Armour and Company  
 Automatic Electric Company  
 Chicago, Burlington & Quincy Railroad Company  
 Chicago Rapid Transit Company  
 Chicago Rock Island & Pacific Railway Co, The  
 Commonwealth Edison Company  
 Crane Co  
 General Household Utilities Company  
 Illinois Central Railroad Company  
 Illinois Steel Company  
 Interlake Iron Corporation  
 International Harvester Company  
 Pullman Standard Car Manufacturing Company  
 Pullman, Incorporated  
 Sears Roebuck and Co  
 Standard Oil Company (Indiana)  
 Swift & Company  
 Western Electric Company  
 \*Wilson & Co Inc

## MOLINE

Deere & Company

## PEORIA

Caterpillar Tractor Co

## ROCKFORD

Ingersoll Milling Machine Company The

## ROCK ISLAND

International Harvester Company  
 \*Rock Island Sash & Door Works  
 \*Servus Rubber Co

## INDIANA

## ANDERSON

Delco-Remy Division, General Motors Corporation

## BUFFINGTON

Universal Atlas Cement Co

## CONOVERVILLE

\*Auburn Automobile Company

## EAST CHICAGO

Youngstown Sheet and Tube Company, The





## CAMBRIDGE

- \*Boston Woven Hose & Rubber Co
- \*Lever Brothers Company

## CHARLESTOWN

- Revere Sugar Refinery

## CLINTON

- Wickwire Spencer Steel Company

## EAST WALPOLE

- Bird & Son Incorporated

## EVERETT

- Colonial Beacon Oil Company, Inc

## FALL RIVER

- American Printing Company

## FRAMINGHAM

- Dennison Manufacturing Co

## HOLYOKE

- American Writing Paper Company Incorporated
- Farr Alpaca Company
- National Blank Book Co
- William Skinner & Sons

## LAWRENCE

- \*American Woolen Company
- Arlington Mills
- Pacific Mills

## LEOMINSTER

- DuPont Viscoloid Company Incorporated

## LOWELL

- Merrimack Manufacturing Company

## MALDEN

- Converse Rubber Company

## NEW BEDFORD

- \*National Silk Spinning Company
- \*Wamsutta Mills

## NORTH PLAMOUTH

- \*Plymouth Cordage Company

## PITTSFIELD

- \*General Electric Company

## QUINCY

- Bethlehem Shipbuilding Corporation Ltd

## SALEM

- \*Naumkeag Steam Cotton Co

## SOUTH BOSTON

- American Sugar Refining Company The

## SOUTHBIDGE

- American Optical Company

## SPRINGFIELD

- Fiberloid Corporation The
- \*Ludlow Manufacturing Associates
- Moore Drop Forging Company
- Spalding A G & Bros
- United American Bosch Corporation
- Westinghouse Electric & Manufacturing Company

## WALPOLE

- Lewis Mfg Co

## WATERTOWN

- Hood Rubber Company Inc

## WEST LYNN

- General Electric Company

## WORCESTER

- American Steel & Wire Company
- Crompton & Knowles Loom Works
- Giaton & Knight Company
- Norton Company
- Whittall M J Associates Ltd

Provisionally approved

## MICHIGAN

## BAY CITY

- Chevrolet Bay City, Division General Motors Corporation

## DEARBORN

- Ford Motor Company
- Highland Park Plant
- River Rouge Plant
- Lincoln Motor Car Company

## DETROIT

- Detroit Edison Company, The
- Dodge Brothers Corporation, Division of Chrysler Corporation
- Fisher Body Detroit Division General Motors Corporation
- Frederick Stearns & Company
- Hudson The J L, Company
- \*Kelley Hayes Wheel Company
- Kelvinator Corporation
- Michigan Bell Telephone Company
- Packard Motor Car Company
- Parke Davis & Company
- \*Timken Detroit Axle Company The
- \*United States Tire Company

## L'AROSE

- Great Lakes Steel Corporation

## LINT

- A C Spark Plug Company, Division General Motors Corporation

## GRAND RAPIDS

- American Seating Company

## LANSING

- Olds Motor Works Division General Motors Corporation
- \*Reo Motor Car Company

## PARCHEMENT

- \*Kalamazoo Vegetable Parchment Co

## SAGINAW

- \*Saginaw Malleable Iron Division General Motors Corporation
- Saginaw Steering Gear Division General Motors Corporation

## MINNESOTA

## DULUTH

- American Steel & Wire Company
- Universal Atlas Cement Co

## MINNEAPOLIS

- Minneapolis Moline Power Implement Company
- Northwestern Bell Telephone Company
- Pillsbury Flour Mills Company
- \*Sears Roebuck and Co
- Washburn Crosby Co Inc

## ST PAUL

- Great Northern Railway Company
- Montgomery Ward & Co
- Northern Pacific Railway Company
- \*Waldorf Paper Products Company

## SOUTH ST PAUL

- \*Armour and Company
- \*Swift & Company

## MISSOURI

## KANSAS CITY

- Kansas City Power & Light Company
- Loose Wiles Biscuit Company
- Sears Roebuck and Co
- Southwestern Bell Telephone Company

## NEW YORK

ALBANY  
A P W Paper Co  
Huyck, F C, & Sons, Kenwood Mills  
New York Power and Light Corporation  
AMSTERDAM  
Bosman, Sanford Carpet Co., Inc.

Michigan-Seward Carpet Co. Inc.  
Mohawk Carpet Mills  
Tuxbury  
International Harvester Company

BRUSHAMPTON  
Alpha Anasco Corporation  
BROOKLYN  
Brooklyn Manhattan Transit System

New York Telephone Company  
Sperdy Gyroscope Company, Inc  
Squibb, F. R. & Sons  
Holland Dry Goods, Incorporated

Buffalo American Brass Company, The  
Buffalo Forge Company

Dold, Jacob, Packing Co  
 Dunlop Tire and Rubber Company  
 Dupont Rayon Company, Inc

Fisher Body Company, Division General Motors Corporation  
Ford Motor Company  
Larkin Co., Inc.

New York Telephone Company  
Pierce Arrow Motor Car Company, The  
Pillsbury Flour Mills Company  
Republic Steel Corporation

WASBURN CROSBY COMPANY, INC.  
WORTHINGTON PUMP AND MACHINERY CORP.  
CORNING  
CORNING GLASS WORKS

CORLAND  
\*Wickwire Brothers  
ELYRIA

Willys-Aldrow Company  
FINDICOTT  
Endicott Johnson Corporation  
International Business Machines Corporation

JAMESTOWN  
Art Metal Construction Company  
LACRAV ANNA  
Northampton Street, Cambridge

LONG ISLAND CITY  
NATIONAL SUGAR REFINING CO. OF NEW JER  
SEY  
MARINERS HARBOR, S I

Procter & Gamble Mfg Company, The  
New York  
American Telephone and Telegraph Co  
Hawley's Trust Company

Bell Telephone Laboratories  
 Consolidated Gas Company of New York  
 Companies  
 Employers Liability Assurance Corp.

•Gambel Brothers  
Federal Reserve Bank of New York  
Horn & Hardart Company, The  
Interborough Rapid Transit Company

International Paper Company  
International Telephone & Telegraph Co., Inc.  
Macy, R. H. & Co., Inc.

## NEBRASKA

OMAHA  
Union Pacific System  
SOUTH OMAHA  
Armour and Company  
Swift & Company

NEW HAMPSHIRE

MANCHESTER  
International Shoe Co

NEW JERSEY  
Ashtington  
DuPont Viscoid Company

Standard Oil Company of New Jersey  
Bayway  
Standard Oil Company of New Jersey

Standard Oil Company of New Jersey  
Camden  
Campbell Soup Company  
Lans, John R. & Company

K C A Manufacturing Company, Inc  
Elizabeth  
Singer Manufacturing Co, The  
Hoboken

United Dry Docks, Incorporated  
Jessey City  
Standard Oil Company of New Jersey

NEWARK  
Western Electric Company  
NEWARK  
Barber, L., & Co

Clark Thread Company, The  
New Jersey Bell Telephone Company  
Prudential Insurance Company of America, The  
PAULSBORO

Socony Vacuum Oil Company, Incorporated  
Pavés Gazo  
du Pont E. I., de Nemours & Company

PERKIN ARBORE  
KANTIAN COPPER WORKS  
ROEBLING

John A. Roebbing's Sons Company  
TREVINO  
John A. Roebbing's Sons Company

Provisionally approved

## SWISSALE

Union Switch &amp; Signal Company

## VANDERGRIFT

\*American Sheet &amp; Tin Plate Co

## WILKES BARRE

Lehigh Valley Coal Company The

## WILLIAMSPORT

Lycoming Manufacturing Company

## WILMERDING

Westinghouse Air Brake Company

## YORK

York Ice Machinery Corporation

## RHODE ISLAND

## PAWTUCKET

Coats J &amp; P (R I) Inc

Lorraine Manufacturing Company

## PROVIDENCE

\*Brown &amp; Sharpe Mfg Company

Builders Iron Foundry

Day of Rubber Company

Gorham Manufacturing Company

National India Rubber Company

U S Finishing Company The

Wanskuck Mills

## SAYLESVILLE

Sayles Finishing Plants Inc

## TEXAS

## BAYTOWN

Humble Oil &amp; Refining Company

## DALLAS

\*Ford Motor Company

## FORT WORTH

Armour and Company

Swift &amp; Company

## HOUSTON

Houston Lighting &amp; Power Company

Humble Oil &amp; Refining Company

Sinclair Refining Company

Southern Pacific Lines in Texas and Louisiana

## UTAH

## SALT LAKE CITY

American Smelting &amp; Refining Co

U S Smelting Refining and Mining Co

Utah Copper Company

## VERMONT

## RUTLAND

Rutland Railroad Company

## ST JOHNSBURY

Fairbanks L and T and Company

## WINOOSKI

American Woolen Company Champlain Mills

## VIRGINIA

## DANVILLE

Riverside &amp; Dan River Cotton Mills

## NEWPORT NEWS

Newport News Shipbuilding and Dry Dock Company

## NORFOLK

Ford Motor Company

## PORTSMOUTH

Norfolk Navy Yard

Provisionally approved

## RICHMOND

American Suppliers Inc.

American Tobacco Company The

Richmond Branch

Virginia Branch

DuPont Cellophane Company, Inc.

DuPont Rayon Company, Inc

\*Virginia Electric and Power Company

## ROANOKE

Norfolk and Western Railway Company

\*Viscose Corporation of Virginia, The

## WASHINGTON

## SEATTLE

Ford Motor Company

Frederick &amp; Nelson

## WEST VIRGINIA

## BELLE

duPont, E I de Nemours &amp; Company

## BLUEFIELD

Norfolk and Western Railway Company

## CHARLESTON

Libbey-Owens Ford Glass Company

## CLARKSBURG

Weirton Steel Company

## CARY

United States Coal &amp; Coke Company

## HUNTINGTON

Chesapeake and Ohio Railway Company, The

International Nickel Company, Inc., The

## MARTINSBURG

\*Interwoven Mills Inc.

## PARKERSBURG

Viscose Company The

## SOUTH CHARLESTON

Carbide and Carbon Chemicals Corporation

## WEIRTON

Weirton Steel Company

## WILLIAMSON

\*Norfolk and Western Railway Company

## WISCONSIN

## BELOIT

Fairbanks Morse &amp; Co

## CUDAHY

Cudahy Brothers Company

## KOHLER

Kohler Co

## MILWAUKEE

\*Bucyrus-Erie Company

Cutler Hammer Inc

Globe Union Mfg Company

International Harvester Company

\*Plankinton Packing Co

Smith A O Corporation

## RACINE

J I Case Company

## CANADA

## ONTARIO

## NIAGARA FALLS

American Cyanamid Company

## THE 1934 HOSPITAL STANDARDIZATION SURVEY

MATCOLM T. MACEACHERN, M. D., Chicago, Illinois

Associate Director American College of Surgeons

Not approved 357  
 Percentage not approved 34.0  
 Total fully and provisionally approved 694  
 Hospitals of 25 to 49 beds 66.0  
 Surveyed 839  
 Fully approved 109  
 Percentage fully approved 20.0  
 Provisionally approved 59  
 Percentage provisionally approved 7.0  
 Not approved 611  
 Percentage not approved 73.0  
 Total percentage approved 27.2

## 4 Government Hospitals

Surveyed 5  
 Fully approved 5  
 Percentage fully approved 100.0  
 Navy  
 Surveyed 15  
 Fully approved 15  
 Percentage fully approved 100.0  
 Public Health Service  
 Surveyed 25  
 Fully approved 25  
 Percentage fully approved 100.0  
 Veterans Bureau  
 Surveyed 73  
 Fully approved 73  
 Percentage fully approved 100.0

## 5 Other Countries

Thirty one hospitals of other countries have been awarded full approval, and are included in the List of Approved Hospitals for 1934  
 Summary  
 Total surveyed 3539  
 Total fully approved 2218  
 Total percentage fully approved 62.6  
 Total provisionally approved 265  
 Total percentage provisionally approved 7.4  
 Total not approved 1056  
 Total percentage not approved 30.0  
 Total fully and provisionally approved 2483  
 Hospitals 100 beds and over 94.6  
 Hospitals 50 beds and over 83.5  
 Hospitals 25 beds and over 70.0

During the past year 3,539 hospitals were registered with the American College of Surgeons for survey. Of this number 2,483 were fully and provisionally approved, thus attaining 70 per cent of all hospitals of 25 beds and over on the Approved List.

Special mention should be made of the excellent services rendered in the field survey by Dr. William M. D., Assistant Director of Hospital Activities, and Field Representatives J. R. Fonton, M. D., and F. C. Bell, M. D., men thoroughly experienced in all aspects of hospital work, who assisted hospitals in the solution of many of their problems at the time of the survey. Their detailed, carefully compiled reports made a valuable addition to the fund of information which the College has on file from surveys made during the past 17 years.

The survey revealed evidence that despite economic conditions, hospitals are maintaining high standards in the professional care of the patient. While continued reductions in budgets and reduction in personnel have been necessary in many instances, the morale of the hospitals generally has been splendidly maintained. Personal interests have been willingly subordinated for the benefit of the patient, and every effort has been put forth to adhere to the requirements which assure the most efficient care of the patient.

The following is an analysis of the results of the survey:

## 1 Hospitals of 100 beds and over

Surveyed 1049  
 Fully approved 1484  
 Percentage fully approved 90.0  
 Provisionally approved 77  
 Percentage provisionally approved 4.7  
 Not approved 88  
 Percentage not approved 5.3  
 Total fully and provisionally approved 1561  
 Hospitals of 50 to 99 beds 94.6  
 Surveyed 1051  
 Fully approved 505  
 Percentage fully approved 47.8  
 Provisionally approved 129  
 Percentage provisionally approved 12.2

## 2 Hospitals of 25 to 49 beds

Surveyed 1056  
 Fully approved 30  
 Percentage fully approved 2.8  
 Provisionally approved 265  
 Percentage provisionally approved 25.1  
 Not approved 1026  
 Percentage not approved 97.1  
 Total fully and provisionally approved 33  
 Hospitals of 25 to 49 beds 30.0

## SWISSVALE

Union Switch &amp; Signal Company

## VANDERGRIFT

\*American Sheet &amp; Tin Plate Co

## WILKES BARRE

I high Valley Coal Company The

## WILLIAMSPORT

Lycoming Manufacturing Company

## WILMERDING

Westinghouse Air Brake Company

## YORK

York Ice Machinery Corporation

## RHODE ISLAND

## PAWTUCKET

Coats J & P (R I) Inc  
Lorraine Manufacturing Company

## PROVIDENCE

\*Brown & Sharpe Mfg Company  
Builders Iron Foundry  
Dycol Rubber Company  
Corham Manufacturing Company  
National India Rubber Company  
U S Finishing Company The  
Wanskuck Mills

## SAYLESVILLE

Sayles Finishing Plants, Inc

## TEXAS

## BAYTOWN

Humble Oil &amp; Refining Company

## DALLAS

\*Ford Motor Company

## FORT WORTH

Armour and Company  
Swift & Company

## HOUSTON

Houston Lighting & Power Company  
Humble Oil & Refining Company  
Sinclair Refining Company  
Southern Pacific Lines in Texas and Louisiana

## UTAH

## SALT LAKE CITY

American Smelting & Refining Co  
U S Smelting Refining and Mining Co  
Utah Copper Company

## VERMONT

## RUTLAND

Rutland Railroad Company

## ST JOHNSBURY

Fairbanks E and T and Company

## WINDSOR

American Woolen Company Champlain Mills

## VIRGINIA

## DANVILLE

Riverside &amp; Dan River Cotton Mills

## NEWPORT NEWS

Newport News Shipbuilding and Dry Dock Company

## NORFOLK

Ford Motor Company

## PORTSMOUTH

Norfolk Navy Yard

Provisionally approved

## RICHMOND

American Suppliers Inc  
American Tobacco Company, The  
Richmond Branch  
Virginia Branch  
DuPont Cellophane Company, Inc  
DuPont Rayon Company, Inc  
\*Virginia Electric and Power Company

## ROANOKE

Norfolk and Western Railway Company  
\*Viscose Corporation of Virginia, The

## WASHINGTON

## SEATTLE

Ford Motor Company  
Frederick & Nelson

## WEST VIRGINIA

## BELLE

\*duPont E L de Nemours &amp; Company

## BLUEFIELD

Norfolk and Western Railway Company

## CHARLESTON

Libbey Owens Ford Glass Company

## CLARKSBURG

Weirton Steel Company

## GARY

United States Coal &amp; Coke Company

## HUNTINGTON

Chesapeake and Ohio Railway Company The  
International Nickel Company, Inc, The

## MARTINSBURG

\*Interwoven Mills Inc.

## PARLERSBURG

Viscose Company The

## SOUTH CHARLESTON

Carbide and Carbon Chemicals Corporation

## WEIRTON

Weirton Steel Company

## WILLIAMSON

Norfolk and Western Railway Company

## WISCONSIN

## BELOIT

Fairbanks Morse &amp; Co

## CUDAHY

Cudahy Brothers Company

## KOHLER

Kohler Co

## MILWAUKEE

\*Bucyrus Erie Company  
Cylinder Hammer Inc.  
Globe Union Mfg Company  
International Harvester Company  
\*Plankinton Packing Co  
Smith, A. O Corporation

## RACINE

J I Case Company

## CANADA

## ONTARIO

## NIAGARA FALLS

American Cyanamid Company

# COMMITTEE AND DEPARTMENT REPORTS

- plaster of paris bandages, specialists plaster of paris bandages, standard surgical dressings, surgical crano line  
H. L. JUD COMPANY, New York, N. Y.  
Day's Curtain Screening Equipment  
B. H. KARNES COMPANY, Milwaukee, Wis  
Lemon's improved portable traction apparatus  
HARRY L. KAYMAN & COMPANY, Boston  
Nonnie rubber sheets  
KAYE & KOTZMAN MANUFACTURING COMPANY, Covington, Ky.  
Keletet tables  
Keletet plate changers  
Keletet transformers in excess of 150 P. K. V  
Keletet X ray accessories  
Keletet X ray transformers of voltages inclusive of 150 P. K. V  
Miscellaneous Keletet equipment  
EWEAVERE MANUFACTURING COMPANY, Kewanee, Wis  
Biology and bacteriology table No. C 350  
Chemical proof sink No. I 195  
Chemical work table No. H 153  
Clinical laboratory table Nos. E 1079, I 1081, I 1083  
Dietetic table Nos. K-1825, K 1830  
Dissecting table Nos. L 1073, E 1078  
Double sink No. A 1883A  
Instrument and display case No. G 1376  
Laboratory truck No. F 1173  
Laboratory wall sink No. F-1182  
Microscope and display case No. G 1333  
Organic chemistry table No. D 857  
Physiological chemistry table No. E 1099  
Private laboratory desk No. H 1524  
Qualitative analysis table No. D 826  
Sink No. K 1879  
Skeleton case No. G 1347  
Sliding sash microscope table No. D 974  
Tapezoidal numeric table No. C 354  
No Ray MANUFACTURING COMPANY, Chicago  
KEELEY COOKER  
LESTER, WHITMAN & COMPANY, New York  
Leather mohair  
LEWIS MANUFACTURING COMPANY, Walpole, Mass  
A. B. D. pads and rolls, absorbent cotton, wadding  
plasters, bandage rolls, cellulose absorbent wadding  
in rolls, cellulose combination pads, cellulose pads, combination dressing rolls, combination pads, combination rolls, crinoline for plaster bandages, dressing rolls, gauze in rolls, molselin adhesive plasters, non absorbent cotton, Norval bandages, O. B. pads, orthopedic stockinette, plaster bandages, ready cut cellulose absorbent wadding, ready cut gauze, salvages gauze, sheet wadding, surgical sponges  
MAKER FORCE COMPANY, Liverell, Mass  
Maforco autopsy tables  
Maforco food veyors  
Maforco mortuary racks  
Maforco refrigerator racks  
MASSACHUSETTS RUBBER COMPANY, Massillon, Ohio  
Maier Knide surgical gloves  
MEYER, BIRT COMPANY, New York, N. Y.  
Medial maternity garments Nos. 6001-6021  
Medial postoperative supports Nos. 6012-6022, 6043-6053  
Medial pedulous abdominal supports Nos. 6027-6047  
Medial pios support Nos. 6015-6025  
Medial sacro and kidney support No. 6016  
Medial hernia and kidney support No. 6058  
Medial maternity brassiere No. 3005  
Medial nursing brassiere No. 3001  
Medial brassiere Nos. 3008 and 3028  
JONSON & JOHNSON, New Brunswick, N. J.  
Absorbent cellulose, absorbent cotton, rolls and balls, absorbent gauze, adhesive plaster, bandage rolls, Bellevue surgical wadding, cellulose wipes, nose and mouth masks, operating room caps, orthoplastic-acoustical tile  
Transite asbestos sheets, Transite asbestos tiles, panels tile, Transite asbestos sheets, Transite insulation, J. M. system of sound insulation, Nashville rigid shingles, J. M. asphalt tile flooring, J. M. home acoustical treatments, Rockoushite, Sanacoustic hold-insulation, J. M. system of sound insulation, Nashville asbestos wainscoting, built up roofing, J. M. asbestos JOHNS-MANVILLE Sales Corporation, New York  
Lundy gas oxygen apparatus  
HEIDENREICH COMPANY, Minneapolis Minn  
Super self contained bromayer mercury arc lamp  
Group irradiation super Alpine sun lamp  
Luxor model, Alpine sun lamp  
Super Alpine sun lamp  
air, N. J.  
HAYOVA (HEMICAL & MANUFACTURING COMPANY, New York  
Hospital beds  
IRANK A. HART & SONS, New York  
Refrigerator  
GRUNOW CORPORATION, Chicago  
Shock pool  
Quartz lamp series  
GENERAL ELECTRIC & RAY CORPORATION, Chicago  
Refrigerator  
GENERAL ELECTRIC CORPORATION, Schenectady, N. Y.  
Alaska sunlight lamps, types S 1 and S 2  
Cleveland, Ohio  
GENERAL ELECTRIC COMPANY, Incandescent Lamp Dept., Cleveland, Ohio  
Refrigerator  
Frigidaire Corporation, Dayton, Ohio  
Metric gas machine  
Henderson infant resuscitation outfit  
Guedel oxygen meter and tent outfit  
Flag resuscitation apparatus  
ONEAGER COMPANY, New York  
Artificial limbs  
ALLEN  
E. H. KRISTSON AGRICULTURAL LAMP COMPANY, Minneapolis  
Luxe emergency lighting battery system  
ELECTRIC STORAGE BATTERY COMPANY, Philadelphia  
X ray intensifying screens  
X ray illuminators  
X ray films  
X ray developing hangers  
Dental X ray film  
Dark room safelights  
Clinical camera  
EASTMAN KODAK COMPANY, Rochester, N. Y.  
Laparosist  
DUKE LABORATORIES, Inc., Long Island City, N. Y.  
Metal furniture and hospital equipment  
N. Y.  
DOERNER METAL FURNITURE COMPANY, Inc., New York,  
Hospital plumbing fixtures for hospital use  
CRANE COMPANY, Chicago  
Corn composition balak inoleum flooring products  
CONQUEST NAYLOR, Acemy, N. J.  
McCarty surgical unit  
CONQUEST OSCILLATOR CORPORATION, New York  
Columbian made enameled ware for hospital use  
HAUTE, Ind  
COLUMBIAN ENAMELING & STAMPING COMPANY, Terre  
Colson wheel chair  
Colson safety inhalator  
Colson invalid chair and accessories  
COLSON COMPANY, Elvira, Ohio  
Colson invalid chair and accessories

- NATIONAL CARBON COMPANY, Cleveland  
Eveready professional model carbon arc lamp  
Eveready solarium type carbon arc lamp
- NORVIC COMPANY Lowell Mass  
Vic crepe bandage
- PATTERSON SCREEN COMPANY Towanda Pa  
Fluoroscopic X ray screens  
Foreign body X ray fluoroscope  
Intensifying X ray screens  
Operating X ray fluoroscope
- PEAUS AMERICAN INSTRUMENT COMPANY New York  
Anatomical specimens for ear nose and throat  
Surgical instruments for ear, nose and throat work
- SAFETY ANESTHESIA APPARATUS CONCERN Chicago  
Safety gas-oxygen apparatus McCurdy models A and B  
Safety gas oxygen apparatus models F and D
- SANBORN COMPANY Cambridge, Mass  
Motor Graphic metabolism tester
- F O SCHIEDINGER Columbus Ohio  
Ohio operating table No 2  
Visible clinical chart desks and portable chart racks  
Elevating wheel stretcher  
Combination bedside and overbed tables  
Adjustable overbed tables crank operated  
Delivery tables C A 2500 and C A 2500-A
- SCIENTALIC CORPORATION OF AMERICA Philadelphia  
Shadowless operating light
- SPLAIN & LLOYD Milford Ohio  
Sani swab cotton wound applicator
- STEDMAN RUBBER FLOORING COMPANY South Braintree Mass  
Reinforced rubber accessories—ash trays bed bumpers  
drain mats molded tops vase plates vases
- Reinforced rubber tile
- STICKLEY BROTHERS COMPANY Grand Rapids, Mich  
Hospital furniture
- STILLE SCANLAN COMPANY, New York  
Surgical instruments of stainless steel.
- TROY LAUNDRY MACHINERY COMPANY, Chicago  
Laundry machinery for hospital use
- UTICA & MOHAWK COTTON MILLS Utica N Y  
Heavy duty muslin sheets
- VESTAL CHEMICAL LABORATORIES St Louis  
Infantol dispenser  
Septisol dispenser
- WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY  
Mansfield, Ohio  
Refrigerator
- WESTINGHOUSE X RAY COMPANY, Long Island City, N Y  
Endotherm
- WILMOT CASTLE COMPANY Rochester, N Y  
Castle lights Nos 10 15 20 30 and 40 autoclaves  
pressure water sterilizers instrument sterilizers uten  
sil sterilizers stills bedpan and urinal sterilizers  
blanket warmers solution warmers sterilizers for  
utility rooms and clinics bulk sterilizers and disin  
fectors bacteriological apparatus
- WILSON RUBBER COMPANY Canton Ohio  
Surgeons gloves
- THE MAX WOCHER & SON COMPANY Cincinnati Ohio  
Mont R Reid major operating table
- CARL ZEISS INC New York  
Lantophos operating room lamp models A and B
- ZIMMER MANUFACTURING COMPANY Warsaw Ind  
Fracture bed and overhead frame



## MEDICAL MOTION PICTURE FILMS

J BENTLEY SQUIER, M D, F A C S, New York, Ni W York, Chairman

Very large audiences were present at all times at the continuous daily exhibition of medical motion pictures during the 1934 Clinical Congress. The 98 films used for these demonstrations included several new talking films with both sound on film and disc recording, and also colored motion picture films.

One hundred and twenty reels of medical motion picture films have been approved by the American College of Surgeons and are available for distribution. Many additional films have been reviewed by the College, and though they have not yet been formally approved, our reviewing committees consider them to be an effective presentation of the subject matter, and the procedures shown to be of interest and value.

Information pertaining to medical motion picture films may be obtained by communicating with the College.

The Board on Medical Motion Picture Films of the College consists of the following members

Will H. Hays Esq., New York, Honorary President  
 J. Bentley Squier, New York, Chairman  
 Philmore E. Truesdale, Fall River, Secretary  
 W. W. Chipman, Montreal  
 George C. Crowell, Chicago  
 Bowman C. Crowell, Chicago  
 Malcolm T. MacEachern, Chicago  
 Franklin H. Martin, Chicago  
 Charles H. Mayo, Rochester

THE importance of motion pictures as a means of disseminating medical knowledge has been generally accepted by the profession, and there is an ever increasing interest in the work of the American College of Surgeons in co-operation with the Motion Picture Producers and Distributors of America, Inc. Films produced under this arrangement are of unusual significance as examples of the possibilities of this method as an aid in the teaching of medicine and surgery.

The College is very glad to receive medical motion picture films for review. Many have already been sent in, and a card catalog is being compiled as the films are reviewed, with the idea of securing detailed data concerning all available medical and surgical films. This will enable us to supply information as to what films are available on any special subject, are satisfactory for the purpose desired.

During the past several years improvements have been made in recording methods and in projection equipment that will be important factors in the application of talking films to the teaching of medicine and surgery. The Board on Medical Motion Picture Films is keenly interested in the development of this type of films and is maintaining close contact with the various organizations concerned with this phase of motion picture production and distribution.

## STATE AND PROVINCIAL SECTIONAL MEETINGS

**D**URING the year 1934, five large and most successful sectional meetings were held as follows

Oklahoma, Texas, Arkansas, Kansas, Missouri—  
Oklahoma City, February 22-23,  
Utah Colorado, Idaho, Wyoming—Salt Lake City,  
February 28, March 1  
Washington, Oregon, Montana, British Columbia—  
Spokane March 6-7  
California Nevada—Los Angeles, March 13-14,  
Arizona New Mexico—Phoenix, March 15-16

These meetings embraced 16 states and 1 province  
The following Fellows of the College and others  
constituted the visiting speakers

Irvin Abell Louisville Alfred W Adson, Rochester, Frederic A Besley, Waukegan, Thomas E Carmody Denver Edward H Cary Dallas, George Crile, Cleveland Frank D Dickson Kansas City, Charles A Dukes Oakland Robert B Greenough, Boston Robert Jolly, Houston Edward Jackson Denver Thomas M Joyce, Portland, Allen B Kanavel Chicago Philip H Kreuscher, Chicago Malcolm T MacEachern Chicago Franklin H Martin Chicago Howard C Naffziger, San Francisco Gordon B New Rochester Rev A M Schmittalla St Louis

Most thorough and complete arrangements were made in advance according to a well worked out and tried plan This assured the success in carrying out every detail of the various phases of the two day meetings

A carefully thought out and well arranged program consisting of 7 phases was prepared and executed at each meeting This was as follows

a Clinics The local Fellows of the College, with their associates or assistants and others, conducted daily clinics from 8 30 a m to 12 00 noon in the approved hospitals of the city in which the meeting was being held These were in the main operative clinics but were sometimes supplemented by dry clinics showing end results in certain types of surgical cases There were also pathological and X ray demonstrations In all 5 meetings more than 200 operative clinics were held These were of special interest and were well attended

b Scientific Sessions Two major scientific sessions were held at each meeting, one on the evening of the first day and the other on the afternoon of the second day The papers at these sessions were presented by the visiting speakers and Fellows of the College from the different states in the group represented These sessions were of special interest not only to Fellows of the College but to the medical profession at large, who were invited to attend The average attendance at these sessions ranged from 800 to 1,000 At the same time as the scientific sessions for general surgery, the eye, ear, nose and throat

section held their special sessions, which too were largely attended and were of intense interest

c Medical Motion Pictures A successful innovation this year was the showing of carefully selected medical motion pictures from 12 30 noon to 2 30 p m daily These sessions were of particular interest The audiences ranged from 200 to 1 800, with an average of 900 to 1 000, despite the fact that the sessions were held at the luncheon hour These demonstrations proved that there is a distinct place for medical motion pictures on the program of these meetings, provided a very careful selection of pictures is made

d Hospital Conference Throughout the 2 days at each meeting a hospital conference was held, consisting of papers, round table discussions and demonstrations dealing with administrative, medical economic and other problems An extensive opportunity was afforded at these meetings for round table discussions and practical demonstrations in all phases of hospital administration and standardization, thus proving beneficial to all present The average attendance at these sessions was 150 to 200 representing in each instance the majority of the hospitals in the states included in each group

e Programs of Public Education During the sectional meeting an extensive and effective program of public education, as to health scientific medicine and hospitals, was carried on in each community where the meeting was being held This program consisted of informative press articles appropriate talks before community service clubs, men's and women's organizations high school and junior college students, and radio broadcasts by the visiting speakers Finally this program culminated in a large Community Health Meeting as the closing session on the evening of the second or last day To this meeting the lay public was invited A program of brief, interesting, and instructive talks on topics of vital interest given by outstanding speakers was well received These talks were in understandable language and were illustrated in most part Through careful working up of interest in each community, the audiences were so large that during the series 5 overflow meetings had to be arranged The attendance at the meetings averaged 2,000 to 12,000 an aggregate of approximately 40,000 not including several thousand in Oklahoma City Salt Lake City, and Spokane who had to be turned away

f Annual Meeting At each sectional meeting the annual meeting of the Fellows of each state was held for the purpose of electing the various state officers for the ensuing year and for the discussion of College activities

g Credentials Committee Meetings At each sectional meeting such state credentials committee meetings were held as were considered feasible

## THE CREDENTIALS COMMITTEES AND COMMITTEE ON HISTORY REVIEWS

Committee. Of those reviewed, 539 sets were accepted and 55 sets were not accepted. Those whose later submitting additional histories. Sixteen meetings were held by the Committee on History Reviews for the purpose of studying his. Congress many additional hours were spent by the members of this committee in order that every can viewed.

The records, half of which were histories of cases of major operations performed by the candidates and the other half abstracts of cases which they had operated upon themselves or at which they had assisted, were checked with the utmost care, particularly with respect to the pre-operative data in dictating the thoroughness with which the case was studied, the technique, and the end results.

The histories which were recognized as being of unusual merit were segregated and were the subject of a special review of the committee as a whole for the selection of those which were considered from the standpoint of completeness, accuracy, and form of presentation to merit special mention.

The members of the Committee on History Review College is greatly indebted for the many hours spent in the laborious work of reviewing the histories submitted are

James H. Bloomfield  
Dwight Freeman Clark  
Harry Culver  
William C. Danforth  
Frank E. David  
Cezar de Takats  
Joseph S. Eisenstaedt  
Oscar H. Kraft  
Philip H. Krenschner  
Francis L. Lederer

Michael L. Mason  
Goldier L. McWhorter  
George J. Musgrave  
Thomas P. O'Connor  
Rudolph J. B. Oden  
Charles H. Parles  
Charles H. Philter  
Charles B. Puestow  
Frederick W. Slobe  
Guy S. Van Alstyne

THE procedure of admitting candidates to Fellowship in the American College of Surgeons requires that each candidate, after filing his application, be recommended by his State or Provincial Credentials Committee before proceeding further with his papers. In each State and Province there is a Credentials Committee composed of from 15 to 35 members who are Fellows of the College, elected to serve on the Committee by the Fellows of the College. One half of the Committee being retired each year.

No candidate is admitted to Fellowship without the recommendation of his State or Provincial Credentials Committee.

The members of these committees give generously of their time and meet at a designated city in their State or Province at least once a year to review the credentials of all candidates whose applications are on file from their respective State or Province. Much credit is due these committees for their part in the work of the selection of the men who comprise our Fellowship.

After a candidate for Fellowship has been recommended by the Credentials Committee of his State or Province, he is required to submit 100 clinical records to the College, 50 in complete detail of major work done by himself and for which he is the responsible surgeon and 50 in abstract of major work at which he has assisted or which he has done himself. These records are carefully examined by the Committee on History Reviews composed of outstanding surgeons in the fields of the surgical specialties from the 4 leading medical universities in Chicago.

This year 626 sets of histories were received and of that number 594 sets or 59,400 individual histories were examined in detail by the Committee on History Reviews. The remaining 32 sets were not reviewed as the applicants had not yet received the approval of their State or Provincial Credentials

## THE LIBRARY AND DEPARTMENT OF LITERARY RESEARCH

THE Library and its allied Department of Literary Research have completed one more year of service to Fellows of the College and members of the medical profession.

The Library of the College was organized in 1921 and had as its nucleus the very splendid collection of volumes which had formed the library of the late Dr John B. Murphy. This collection has been augmented by the addition of such libraries as that of the late Dr Albert J. Ochsner, a broad but well chosen and practical collection, fittingly presented by his heirs; the library of the late Dr William McDowell Mastin of Mobile, Alabama, which includes eighteenth and nineteenth century volumes in French and English; back files of journals as well as material having current reference value; and the very splendid collection of historical works and current monographs which Dr H. Winnett Orr of Lincoln, Nebraska is assembling.

In addition to the outstanding gifts above mentioned, Fellows and friends of the College have contributed many very valuable small collections and individual volumes, some consisting of treatises of historic interest and others of current reference works, especially valuable aids in the various pieces of research which are being carried on in the Department. Individual reprints and more extensive files have likewise been received.

In order that the Library may be truly representative of the work of every Fellow, that this great mass of valuable material may be preserved to posterity and that it may be available to any member of the profession who is studying similar or allied problems, every Fellow of the College is requested to contribute one copy of each of his monographs and two copies of his reprints (one for the Fellow file and one for circulation in the package library collection). Fellows are further urged to notify the Librarian of any collections which they themselves are in a position to present either now or at a later date, or which at their suggestion might be offered to the College—that these too may enter into a broader field of service and be made available to surgeons in New Zealand as well as to those in Chicago.

The availability of the Library is a factor dependent upon the services offered by the Department of Literary Research. The Department con-

sists of a small group of workers especially equipped to select reprints, compile bibliographies, and prepare abstracts and translations on medical and surgical subjects. If reprints only are desired these can be supplied without charge in package library form; bibliographies, abstracts and translations are furnished at a nominal fee.

During the past year many individual requests for research have been received, some of them being continuous surveys which have earned through the year and have required weekly or monthly reports. Some pieces of research have required a series of abstracts or complete translations chosen from an extensive bibliography—others called for careful combing of all available sources for data on subjects upon which very little has been written.

Whatever the need of the individual Fellow—whether a review of the literature including extensive translations from the German, French, Italian, Spanish, Rumanian, or Scandinavian languages, or a simple bibliography compiled from the published indices—the staff is prepared to care for it efficiently. The Department has a high aim—to bring the literature of the world to the doorstep of every Fellow of the College whatever his need and wherever he may be located and to do this expeditiously and economically.

## PORTRAITS AND MEMORIALS IN THE LIBRARY

The Albert J. Ochsner Memorial Room contains the collection of photographs assembled by the late Dr Ochsner, founder, treasurer and past president of the College as well as mementos of his life and work. Portraits of Dr and Mrs Elijah Dewey Harman, physician and surgeon at Fort Dearborn in 1830 and a portrait of Mrs. Maud Mellish Wilson, who has done so much for the advancement of literary and editorial standards in medicine and surgery, have recently been received. Mementos of historical significance—the mortar and pestle of the early physician and the medicine chest of the venturesome surgeon who accompanied the early French explorers along the Mississippi—these and other items of historical significance have been fittingly placed in the Library where it is hoped they will serve as an incentive for further gifts of a similar nature.

## BOSTON COMMITTEE ON ARRANGEMENTS

Secretary, Otolaryngology, Theodore L. Terry,  
Secretary, Ophthalmology

## OFFICERS ELECTED

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nesota

Vice-Presidents Arthur W. Allen, Boston, John  
A. Gunn, Winnipeg

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R. Charles H. Mayo, Rochester, Minnesota, Alexander  
R. Munroe, Edmonton, J. Bentley Squier, New

York

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J. Buchanan, Pittsburgh, Thomas O. Burger, San  
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Indianapolis, Robert E. Halahan, Buenos Aires,  
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Richmond, John O. McKeynolds, Dallas, James F.

Mitchell, Washington, Benedicto Montenegro, Sao  
Paulo, Howard C. Naffziger, San Francisco, Julio

Nin y Silva, Montevideo, E. Payne Palmer, Phoe-  
nix, William W. Pearson, Des Moines, Alexander

Primrose, Toronto, Alexander Randall, Philadel-  
phia, Edwin P. Reed, Valparaiso, James A. Sher-

bondy, Youngstown, David Silver, Pittsburgh, Fer-  
nis Smith, Grand Rapids, William Harvey Smith,

Winnipeg, Robert B. Stewart, Topeka, Raymond P.  
Sullivan, New York, John E. Summers, Omaha,

Agnes C. Victor, Boston, James Craven Wood,  
Cleveland, Arthur M. Wright, New York.

Members of the Board of Governors for term ex-  
piring in 1935 F. Gregory Connell, Oshkosh, to serve

the unexpired term of Burton J. Lee, deceased,  
Austin B. Schindler, Vancouver, to serve the un-

expired term of Frederic N. G. Starr, deceased  
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serve the unexpired term of Robert C. Coffey, de-

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Hubert F. Day, Augustus W. Dudley, John C.  
Eckels, David Edsall, Jacob Fine, Seth Ritchet,  
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Hutchins, Charles I. Johnson, Stephen Jones,  
George T. Keenan, William E. Ladd, Frank H.  
Lahay, Walter B. Lancaster, Harry J. Lee, Edward  
Leonard, Halsey B. Loder, Moses H. Lurie,  
Francis X. Mahoney, Patrick J. Mahoney, Henry C.  
Marble, Leland S. McKernick, Joe V. Meigs, Charles  
G. Mixter, William J. Mixter, Gordon Morrison,  
Harris P. Mosher, Dwight O'Hara, Robert B.  
Osgood, Alfonso K. Paine, Frank A. Remberton,  
Louis E. Phaneuf, William C. Quincy, Lyman  
Charles L. Schuder, William M. Shelden, Channing  
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A. Warren Stearns, Horace P. Stevens, Loring T.  
Swann, Channing Swan, Theodore L. Terry, J.  
Herbert Waite, Irving J. Walker, Shields Warren,  
Kaph Wiggins, Charles F. Winsky, Philip D. Wil-

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Horatio Rogers, Secretary

Scientific Exhibits—Robert B. Greenough, Chair-  
man, Channing C. Simmons, Secretary

Harvard Medical School Program—David  
Cheever, Chairman, Magnus I. Gregerson, Secre-

tary

Public Meeting—Alexander Begg, Chairman,  
Dwight O'Hara, Secretary

Circular Bulletin—Frank Ober, Chairman  
Ophthalmology and Otolaryngology—George

L. Tobey Jr., Chairman, Lyman Richards,  
L. Tobey Jr., Chairman, Lyman Richards,

# HOSPITAL STANDARDIZATION

## REPORT OF THE 1934 CONFERENCE IN BOSTON

**A**N abstract of the papers and discussions presented at the seventeenth annual Hospital Standardization Conference held in Boston, October 15-18, 1934 is found in the following pages. Dr. William D. Haggard, past president of the College, presided.

### THE NEW DEAL IN HOSPITALS

**WILLIAM D. HAGGARD, M.D.** Nashville. The changing conditions in the economic structure make it incumbent upon the hospital to keep step with the progress of other forces in our social fabric. The prepayment plan of hospitalization employed in many quarters, has the new principle of allowing people of very moderate means who cannot or will not budget their incomes to make provision for sickness. The insurance principle has through all of the depression been the one thing that has stood up; it is so strongly ingrained in American institutions that it deserves a fair trial in the hospitals.

The training school for nurses should receive a great deal of thought at this conference. There is an enormous surplus of nurses in this country and this is working a hardship because of severe unemployment conditions. The plan to utilize graduate nurses wherever possible with ward service maids commends itself for serious consideration. If fewer nurses could be graduated all could receive employment; the patients would not suffer and the hospitals would not lose thereby.

Hospitals must have more regard for the rights of the patients who are often, on account of illness and fear, not in a position to fend for themselves as people do in health. The principle employed in the best hotels that "the guest is always right" should be a slogan in every hospital. *The patient is always right.*

The rôle of the hospital as a finishing year for graduates in medicine should ever be borne in mind. Ample living quarters with a working library and an increased number of autopsies should be provided. The best hospital attracts the best interne. Moreover, the type and efficiency of the interne are of incalculable benefit to the hospital.

The standardization program of the College has been an inspiration and a means of stabilization to all hospitals. Medicine and nursing have anticipated the policies of the New Deal. The embodiment of a definite code of ethics in business and industry is a wise and beneficent extension of the age-old ethics which have ever been practiced and cherished by both professions.

The United States and Canada contain the best and the largest number of hospitals of any country in the world. They have lived up to their opportunities, are making great progress, and will adapt themselves to the needs of our economic condition, whatever it may be. Trustees who have the responsibility, superintendents who have the leadership, directresses of nurses who inculcate the blessed art of nursing, the physicians and surgeons, who by example and precept, combine the tender solicitude of heart with gentle and willing ministrations, will in the future as in the past, make our American hospitals the greatest institutions of our civilization.

### SEVENTEENTH ANNUAL HOSPITAL STANDARDIZATION REPORT

**FRANKLIN H. MARTIN, M.D.** Chicago. The Hospital Standardization movement has proved to be of distinct benefit not only to the hospitals which have achieved approval but also to the patient, the physician, the interne, the nurse, and the community.

Hospital Standardization assures efficient care to the patient through better medical staff organization, competent personnel, and adequate diagnostic and therapeutic facilities. Further, the writing of medical records, the examination and study of pathological specimens, the regular review and analysis of the clinical work, and many other procedures of detail and precision assure a more accurate diagnosis and rational treatment for the patient. All this means speeding up treatment through shortening the days' stay in the hospital, reducing complications, and what is more important, lowering the mortality rate.

The approved hospital provides the physician with a proper environment in which to work. Not only has he the necessary facilities at his disposal, but also a well-trained staff to assist him. Through recording the history of his patient, through proper use of the diagnostic and therapeutic facilities, the staff conference, the clinicopathological conference, and other features made available in the approved hospital, the physician is not only able to give better care to his patient, but because of organized and systematized efforts he is constantly improving his armamentarium of scientific knowledge. Finally, his own professional status is improved, for he is known as an ethical practitioner who takes a definite stand against the splitting of fees.

The hospital finds it an advantage administratively, socially, and economically to be approved.

1934—118 hospitals surveyed	3,538
100 percentage approved	2,209
118 hospitals fully and provisionally approved	624
Total fully approved	76
Total percentage fully approved	2,1
Total percentage provisionally approved	1,058
Total not approved	300
Total percentage not approved	2,480
Total fully and provisionally approved	946
Hospitals 100 beds and over	834
Hospitals 25 beds and over	700

#### GUIDING PRINCIPLES FOR PAYMENT OF HOSPITAL AND MEDICAL SERVICE

CHARLES A. DUKES, M. D., Oakland There are certain definite general principles to be followed in the organization of any periodic prepayment plan which are directed toward obviating the known difficulties and dangers threatening the success of special forms of medical and hospital service. The American College of Surgeons has stated these principles as follows:

"a. Periodic prepayment plans for medical service should be free from the intervention of commercial intermediary organizations operating for profit. After deduction of the clerical costs of operation of the fund and such accumulation of reserve as may be advisable in the interests of the contributors or may be legally imposed, the full amount paid by the contributors should be available for medical and hospital services.

"b. In the interests of the patient, the organization of plans for the periodic payment of medical and hospital costs must be under the control of the medical profession in co-operation with the hospitals, and such other allied services as may be involved in the individual project, together with a group of citizens representative of the whole community and of industry who are interested in the successful operation of the plan.

"c. The principle of free choice of physician and hospital by the patient must be assured to the end that the responsibility of the individual physician to the individual patient shall always be maintained. When hospitalization is required, this choice must be limited to the physicians and surgeons who hold appointments on the staffs of the hospitals participating in the plan or to those physicians and surgeons who are acceptable to the hospital. It is further recommended that only approved hospitals be admitted to participation in such a plan.

"d. The compensation of the physician and of the hospital should be estimated with due regard to the resources available in the periodic payment fund and should be based upon the specific services rendered.

#### A SUMMARY OF REPORT—1918-1934

OVER 1918-602 hospitals surveyed

89 hospitals fully and provisionally approved  
12 percentage approved  
1,649 hospitals surveyed

1934—1,609 hospitals surveyed  
413 percentage approved  
1922—812 hospitals surveyed  
335 hospitals fully and provisionally approved  
1922—131 hospitals surveyed  
50 to 99 beds  
1924—307 hospitals surveyed  
49 hospitals fully and provisionally approved  
159 percentage approved  
839 hospitals surveyed  
228 hospitals fully and provisionally approved  
272 percentage approved  
(4) Ten surveys of Government hospitals of the United States  
1925—100 hospitals surveyed  
90 hospitals fully and provisionally approved  
90 percentage approved

which makes for a more complete and efficiently functioning organization as a whole. The minimum standard provides the hospital with fundamental principles pertaining to the best plan for assuring good professional care to patients. The carrying out of the principles of the minimum standard gives better assurance that the administration is functioning in a manner to best fulfill its purpose. Because of its organization, equipment, and personnel the approved hospital affords the interne and the nurse better supervised experience. To this end, it is now customary for young graduates of medicine and student nurses to seek information as to which hospitals are approved. In most instances, the community is directly or indirectly interested in its hospitals. The fact that they are living up to universally acknowledged and accepted standards of professional organization and service should give the community greater confidence and pride in such institutions. Indeed, many people requiring hospitalization today seek the approved hospital knowing that such an institution is organized so as to give adequate care and efficient service to the sick and injured. Now I have the pleasure of presenting to you the annual Hospital Standardization report for 1934.

"e The organization and operation of any plan of this type must be free from any features not in accordance with the code of ethics of the medical profession, which code has been established for the protection of the patient

"f The medical organization participating in such a plan must assume responsibility for the quality of service rendered"

The American College of Surgeons condemns the practice which involves the sale of a contract by an industrial organization to an individual physician or group of physicians for medical or hospital services for its employees. Such a practice encourages commercial competition and should, therefore, be entirely eliminated.

It is my belief that the duty of assuming leadership in this movement rests with the medical profession and the hospital field, who should take control of all measures directed to this end. They should not frown upon new methods of practice designed to meet the needs of the public for medical and hospital care. Rather they are the ones who should encourage the trial of new methods. However new plans should be carefully evaluated as to the success of their results before they are offered for general adoption. And the evaluation must be made by the medical profession and the hospital field themselves.

#### THE DEVELOPMENT OF PERIODIC PREPAYMENT PLANS FOR HOSPITAL CARE IN ENGLAND

SIDNEY LAMB M.B.L. Liverpool. There are at present in Great Britain over 6½ million subscribers to British Hospital Contributory Schemes, who with their dependents comprise approximately 15 million individuals assured of hospital care in case of necessity without additional cost to themselves. In June 1934 there were 10 million employed persons compulsorily enrolled under National Health Insurance and as the voluntary hospital contributory funds mainly include persons insurable under the National Insurance Acts it is evident that about two-thirds of the compulsorily insured population of England are also entitled to receive hospital maintenance. The official policy of the British Hospital Contributory Schemes Association is that all persons within the national health insurance income limit should ultimately subscribe and that the total amount of their subscriptions should be sufficient to meet the full cost of maintenance in a voluntary hospital.

It was not originally intended that the subscriptions from the workmen and people of limited means would suffice to cover the cost of the hospital care that they would receive. It was felt however that the contributions received in this way would be much greater in total than the meager voluntary contributions made by these people at times of hospital illness. The British Hospital Contributory Schemes were not primarily 'insurance plans' for distributing the cost of medical care among people accustomed to paying hospital bills at the time of their sickness.

The estimated average amount paid by English contributory funds to the voluntary hospitals is about ten dollars a week, equal to about 70 per cent of the actual cost of maintenance. This does not, of course, reimburse the hospitals for their services. But when one considers that English workmen as a class paid considerably less than half the cost of services received before the contributing schemes were introduced, the voluntary hospitals may be regarded as propping by the new plans. There is a growing consciousness that English contributory funds must accept an obligation of meeting the full cost of maintenance of contributors in voluntary hospitals. A few schemes have done so. The contributors receive free care from the attending staffs of the hospitals, although procedures are in effect in some places by which members of the hospital staffs are paid from the contributing funds.

There are approximately 150 contributory schemes in England, and nearly every voluntary hospital participates in the benefits of a contributory fund, either as a single institution with a limited number of subscribers or as one of a group of hospitals serving an entire community. The larger funds hold membership in the British Contributory Schemes Association, which includes about 130 schemes.

The contributory schemes are usually organized on a community basis as civic movements under the sponsorship of many important agencies. A 'council' guides the activities of collecting funds from subscribers and making payments to the participating hospitals. Usually there is free choice, not only among participating institutions, but among voluntary hospitals elsewhere.

The hospital contributory schemes are officially and enthusiastically endorsed by the British Medical Association, which also recommends that self supporting plans for the 'middle classes' be adopted throughout the country.

#### THE HOSPITAL IN RETROSPECT AND INTROSPECT

ALPHONSE M. SCHWITALLA S.J., Ph.D., St. Louis. As the gospel of standardization is the ultimate ideal of civilization so have we striven for standardization in hospital activity. Nature preceded standardization and standardization is regarded as an improvement on nature. In early days one hospital was not like another in atmosphere in effectiveness, in procedures in personnel they differed one from another.

Today we have the satisfaction of knowing that even though there are more hospitals than ever before they are also more uniformly better. We have given to the people the service which was demanded. Even though impossible demands have been made, the hospitals have not been content merely to say 'this is impossible' they have done the impossible. They have made themselves—all in one—magnificent hotels, fully equipped scientific laboratories, schools for professional training, dynamic centers of social influence, nursing homes, and in many cases placement centers. No other single group of institutions has been expected to serve so



many, such diverse, and such important needs of today's civilization. And the hospital has fully answered the demands made upon it.

This impossible task has become possible through a clearer definition of means, a searching work analysis, the adaptation of means toward the objectives, the definition of requirements, and the enforcement, largely voluntary, on the part of hospitals themselves of the standards based upon needs and the tasks to be performed to fulfill those needs. In short, it has been made possible through the process of standardization.

And yet, in our efforts to bring institutions to a uniform degree of achievement and excellence, have we lost nothing at all? It is a universal law of nature that everything achieved must be paid for in sacrifice—that success here means failure somewhere else. Is it not true that when all things are done, all problems solved, and all difficulties answered by a *uniform formula* the institution ceases to live actively because it has ceased to vary actively?

Each new adaptation in nature is only a precursor of a succeeding adaptation, an adaptation to environment when it becomes static spells death to type and individual adaptation which progresses spiral, greater excellence and greater perfection. I plead, therefore, for increased activity of those internal forces which express themselves in initiative, resourcefulness, new ideas, new applications, the research spirit, the conscious effort to vary, to do so because I cannot but be convinced that only by paralleling progressive standardization and progress individuality can the hospital be of the greatest service to a constantly changing local and national environment.

My hope is that hospitals may be guided by the professional organizations which are re-creating them. But my further hope is that in that re-creation there shall be as much emphasis upon the re-creation, the re-creation implies permanent adaptation to a changing process with prudent wisdom in accord with its individuality, and continue to serve in close co-operation and harmony with other institutions like itself, the needs of this changing world. The hospital type will best be preserved by preserving the hospital's individuality.

#### FUTURE TRENDS IN HOSPITAL MANAGEMENT AND SERVICE

There is a very definite tendency toward standardization and care of tuberculous cases—particularly in the incipient stages. There is a very definite tendency to use hospital service for communicable diseases instead of sending these cases to "pest houses." In developing this program the hospitals are affording improved opportunity for the training of interns and residents in psychiatric, tuberculous, and communicable disease clinics. There is a definite movement in hospital service to provide prenatal care and to supervise the expectant mother during the prenatal and postnatal periods. There is a definite trend, amounting almost to a material change, in the development of adequate maternity services in the general hospitals. Hospital service is showing a marked tendency toward a closer association with the general day nosc clinic, the treatment and prophylactic clinics. The larger problem in hospital management today is to encourage the use of existing hospital facilities as to the hope of the hospitals that every person suffering from any disability or disease whatsoever may have the advantage of competent hospital care in a hospital near his home, at the earliest moment, without economic disaster following his hospital care. The utilization of existing hospital facilities, with each institution giving a satisfactory professional service, would solve the economic difficulties not only of the institutions themselves, but of the members of the medical and nursing professions who staff them.

There are not sufficient hospital facilities in the metropolitan centers of the country—in the tax-supported institutions, in the municipal and county general hospitals—to take care of the indigent sick who apply for admission. Had it not been for the "voluntary" hospitals' service to the sick poor during the past 4 years, the people of this country would have suffered beyond any conceivable measure. There must be full recognition of the fact that the changing era has brought varied problems, and that the old order of things, so long established and serve the best interests of public, physician, and hospital alike.

Leadership in thought and action must come from these associated groups. This leadership must develop that order of thought, that system of procedure, to which the public will give its sympathetic co-operation, the system that will secure a unanimity of support, and that will provide on the one hand the desired medical and hospital care for all of our people, and on the other hand a fair remuneration for the services which physicians and hospitals render.

#### THE PROPER INTERPRETATION OF HOSPITAL SERVICE

NEWTON E. DAVIS, D.D., Columbus, Ohio  
Hospital service, properly interpreted, includes the very best type of organization as it relates to the management of

ment and departmental service of the hospital. The importance of saving human life makes it necessary that the very best trained personnel be placed in charge of the organization which is responsible for the planning of the institution. For too long a time organization under trained leadership has been for tuitous rather than required in hospital service. Too many hospitals have been merely boarding houses with some facilities for the nursing of the sick.

The modern hospital must meet all the requirements of the highest form of organization in its every department. This requisite covers trained experts in accounting, business administration, and departmental organization. The hospital is responsible for the technical service which is rendered to the patients. It is therefore necessary that all of the technical service such as laboratory, X-ray, metabolism and other types of special service shall be conducted by people who are specially trained to handle the departments to which they are assigned.

A proper interpretation of hospital service as it relates to the standard of medical and surgical practice has been made by the American College of Surgeons which through its promotion of staff organization and departmentalizing of medicine and surgery has laid down fundamental principles which should be recognized and followed by every hospital in the world which expects to render the highest type of service to the patient. Every new procedure which the American College of Surgeons has set forth during the past 15 years has been a step in the right direction. But the hospitals have been slow in accepting these high requirements and many are yet without the necessary standardization and staff program hence are not rendering to the public the type of scientific service which they could render if they were properly standardized.

Marked advance has been made in nursing education in the United States and throughout the world in general. The insistence of the American College of Surgeons that medical and surgical practice be of the highest type has necessitated improvement in the theory and practice of nursing service. The progress made has been in keeping with the increased efficiency and effectiveness in hospital organization, technique and standardization. The hospital which merely runs a boarding school for young women with some practical nursing service, cannot qualify today under the heading of a modern hospital.

The hospital has long passed the period of being merely a life saving institution. The proper interpretation of the modern hospital leads us to state that a hospital must through its visiting nurses its interne service, as well as the service of the medical and surgical staff consider the public as a vital part of its program. The relationship of the hospital to the work of public agencies such as child welfare organizations, public health clinics and the agencies which are working socially for the control of epidemics and communicable diseases, must be established. In this regard the hospital acts as a co ordi-

nating unit which relates the individual who is ill to the community as a whole, and likewise brings the public into a definite social relationship with the hospital.

#### PRINCIPLES GOVERNING THE RELATION OF RADIOLOGISTS TO HOSPITALS

ARTHUR C. CHRISTIE, M.D., Washington, D.C.  
The radiologist must be a duly licensed physician with adequate training and experience in all branches of radiology. The radiological department must be under the direction of the radiologist, and he or a qualified assistant must spend ample time therein to see every patient and to supervise every examination or treatment. His service must be such as to insure the element of medical consultation in every case examined in the department. His financial arrangements with his patients must be the same as those of other members of the staff; that is, he should fix the fee for services in each case. His financial arrangement with the hospital must be such that the hospital receives ample payment for all expense incurred by it, including a sufficient amount to cover obsolescence of apparatus. On the other hand, the hospital should not make a profit from the operation of the department nor in any way share or fix the fees of the radiologist.

Much advantage accrues to the hospital when the radiologist draws to his department a considerable percentage of his work from outside. The hospital increases its prestige by having a first class radiological department and increases its percentage of bed occupancy through the hospitalization of patients being treated in the radiotherapy department. An additional advantage of great importance is that this is a method by which a hospital of even moderate size may have a first class radiological department which is entirely self supporting. Such advantages quite offset any advantage to the radiologist from his so called monopoly of the work in that hospital. It has been said that the hospital must offer to the radiologist a 'special concession' but the fact is that the 'concession' is mutual. The radiologist must abandon the advantages of private office practice, must be subject to the calls of emergency work and must do a much larger percentage of charity work than he would in a private office location.

In addition to routine duties which require full time service in the hospital, the radiologist must do his part in instructing internes and residents, also in attending and taking part in all clinicopathological conferences of the staff. Furthermore, he must have frequent consultations with the hospital pathologist on cases studied by both.

The American Board of Radiology has now taken its place among the examining boards for the specialties and there are already indications that it will exert a most wholesome influence in raising the standards of radiological practice. It is confidently expected that hospital accrediting and standardization agencies will presently require that the heads

of radiological and other special departments shall be diplomates of the special examining boards, thus helping to insure high quality of service in every department

## STANDARDS FOR OBSTETRICAL SERVICE

### IN HOSPITALS

GEORGE W. KOSMAK, M.D., New York. When we discuss standards we must have in mind not the adoption of mere routine procedures which are applicable to all cases, but rather the adoption of those procedures which have been found by trial and experience to be the safest and most suitable. Then we must make use of them in the individual case with whatever modifications may be necessary.

It should be the aim of good obstetrical service to restore the patient to her previous natural life. She may have been severely damaged by a labor accompanied by operative delivery. Her generative organs may be displaced, her genital tract lacerated, her kidneys damaged, and other organs affected in such a manner that they have not returned to normal, and yet she may have failed to show these conditions through a rise of temperature. The arbitrary interpretation placed on temperature readings in most hospital services is evidently in need of revision.

The development of adequate standards for the hospital care of pregnant patients will be reflected in the home care of such women. In addition to so-called "standards" we must consider other factors admitted that the increase of hospital deliveries has not resulted in a corresponding decrease of maternal mortality and morbidity. Hospital confinements in many instances seem to have degenerated, if I may be allowed that expression, into more or less artificial forms of delivery, and it is worthy of note that in many sections of this country the operative incidence has increased by leaps and bounds during the past few decades. Also worthy of note is the considerable variation among individual institutions. Large public hospitals report over 70 per cent of normal deliveries, private hospitals, well known and acknowledged to be excellent, show less than 50 per cent of normal deliveries. Undoubtedly, reform in hospital management of labor cases is necessary, and there is equal need for developing standards which will improve the situation.

OBSTETRICAL COMPLICATIONS IN THE WOMAN'S HOSPITAL, NEW YORK, STUDIED IN ORDER TO ESTABLISH PROPER STANDARDIZATION FOR STATISTICAL PURPOSES  
GEORGE GARY WARD, M.D., BYRON H. GORE, M.D., and ALBERT H. ALDRIDGE, M.D., New York.  
The usual practice of obstetrical clinics in reporting their maternal morbidity in percentages based on five postpartum temperature criteria is of little value for comparison, since there is no uniformity in the methods employed. At best it is only an in-

accurate index of possible puerperal sepsis, and takes no account of the many other serious complications which are certainly "morbidity." We believe the object of reporting maternal morbidity should be to establish data as to whether or not the function of bringing a child into the world has been a normal process. Therefore, if a woman at any time during her pregnancy, labor, or puerperium has a condition or disease which complicates the process of child bearing so that it is not normal, it should be classified under the heading of maternal morbidity if this term is to be used, irrespective of whether the abnormal condition has a certain degree of postpartum fever as a symptom. And in many instances, an alone is an insufficient criterion to use if we would correctly classify our morbidity cases.

Studies of our cases show that certain patients have significant postpartum complications without any elevation of temperature, and that some patients have complications with slight persistent febrile reactions who would not be considered "morbidity" by any of the prevailing criteria. If our purpose is to determine whether or not a certain pregnancy is normal we believe that the case should be considered throughout the entire process from the onset to the completion of the involution. Therefore, the antepartum, intrapartum, and postpartum studies, instead of basing maternal morbidity rates on one symptom alone, namely a rise in temperature, we will be able to have a much better appreciation of the price of childbearing and the efficiency of our care.

For purposes of comparison and evaluation of methods, a knowledge of the temporary or permanent maternal displacement of our patients as a result of childbirth will be of more value than the estimation of possible sepsis as indicated by a single rise in temperature, which is all that the "morbidity" rate now in vogue means. "Objections to present criteria for so-called 'puerperal morbidity' may be summarized as follows: (1) criteria are not uniform, (2) criteria are based entirely on one symptom, rise in temperature. (3) certain patients have significant postpartum complications without any elevation of temperature. (4) certain patients have significant complications with slight persistent, febrile reactions, who would not be considered 'morbidity' by any of the present criteria. We feel that there is an urgent need for uniform standard for the determination of morbidity. Such a standard should be considered of all symptoms and give rather than upon a single symptom. We suggest that the standard be sponsored by a national organization such as the American Surgeons. We would suggest that the term 'puerperal morbidity' be abandoned, and the vagueness of its meaning, and the conditions and diseases associated with it.

be classified under three headings, namely ante partum intrapartum and postpartum complications, as has become our practice at the Women's Hospital during the past year

#### REGULATION AND CONTROL OF OBSTETRICAL PRACTICE OF NON-STAFF PHYSICIANS IN INSTITUTIONS

SAMUEL A. COSGROVE, M.D., Jersey City. In no field has the liberalization of staff practice been broader than in obstetrics. Many a general hospital, the surgical service of which remains uncompromisingly closed, permits a wholly open field to anyone desiring to admit obstetrical patients. And in no other field is such untrammelled practice by physicians of little or no special competence capable of such tragic results.

Through questionnaires sent to 46 general and special hospitals it was found that 71.4 per cent of the obstetrical services are 'open' so far as private patients are concerned, only 5.7 per cent so far as public patients are concerned. Of the total services 'open' only 70.4 per cent claimed control of practice.

Hospitals generally would fall into 3 classes so far as control of obstetrical practice is concerned. In the first group adherence to technique only is required. Control by indirect moral suasion only is exercised in group two. In the third class are those hospitals which control by courtesy staff grading. Control is achieved in the fourth group by restriction of appointment to 'courtesy' staff. In group five control is by specific requirements of consultation, strongest where such requirement is universal and unequivocal.

The establishment of paper rules by no means suffices to safeguard patients. Some provision must be made for the constant contact of the institution with the patients. This the Margaret Hague Maternity Hospital provides through residents, young men of adequate obstetrical training and competence who are constantly associated with the courtesy staff attendants in estimating obstetrical situations from time to time. This association is unobtrusive, tactful and is usually welcomed by the attendant. Indeed so dependent do some physicians become on the residents that it has been necessary to issue a specific ruling against the residents exercising a consultative function in relation to them.

Occasionally however the outside man resents the surveillance of his work and it is then necessary for the resident to act with firm decision, forbidding illicit interference if necessary, pending contact with executive authority. We cannot escape the fact that hospitals do owe a direct moral responsibility to all patients admitted and must see to it that they receive medical care of high competence even if the physician of the patient's choice be not capable of giving it without the augmentation of his capacities through the consultation and assistance of others.

In any hospital the adoption of regulations pertaining to the work of the attending staff must be reinforced by constant active scrutiny of their

actual operation by a chief or director with definite executive power lest regulations become non-effective.

In the Margaret Hague Maternity Hospital no mother has ever died because she was permitted to remain in the sole care of an inadequately trained and inexperienced practitioner. Such a splendid record would justify every institution's maintaining rigid control of practice.

#### DISCUSSION

JAMES RAGLAN MILLER, M.D., Hartford. I believe that hospital reports should have, each year, a concise statement showing the background of the clinical material. Is the staff open or closed? What proportion of its cases are residents or non residents? What is the proportion of residents compared to total deliveries of the city's residents? What kind of patients are represented—economically? Racially?

Before evaluating any hospital report one should know whether each physician is careless about summarizing his history on discharge or whether a benevolent despotism forces him to do truthful and accurate reporting. There is undoubtedly a drive on for more accurate and thorough control, and hospital staffs should realize that if they are unwilling or unable to exercise this control the lay management of the hospital is going to exercise it in a more direct and perhaps less pleasant manner. At present most of our organizations fighting the battle of maternal mortality and morbidity are controlled by committees, a method which is not calculated to produce good results.

In our community hospitals it is almost impossible to get the obstetricians to write the history and physical examination on their private patients' records. Most private patients resent a perfunctory history and physical examination done by an interne a day or two after delivery. In order to span this gap, we have persuaded the Connecticut State Department of Health to print and distribute an obstetrical reference card to all physicians doing obstetrics. It is urged that the record of the first examination be sent forthwith to the hospital where confinement is to occur. This will be of service to the hospital in gauging its prospective number of births, in supplying information which is now often lacking on the histories, it will also be of service to the obstetrician himself, who arrives at 2:00 a.m. for example to deliver Mrs. X and who does not recall what he found at his first examination.

If hospitals will furnish this prenatal record on their own stationery, it will be much more satisfactory. The success of the "Medical Reference Card" for general cases which has been used in Connecticut for the past several years has been such as to lead us to believe that the obstetrical card will also meet a need.

#### THE FUNDAMENTAL PRINCIPLES UNDERLYING THE MECHANICS AND TECHNIQUE OF STERILIZATION

HURLEY T. WYATT, Madison, Wisconsin. Since the time that Pasteur and Lister made their out

the dressings properly in the sterilizing chamber from which the air has been removed. By means of the vacuum ejector and other devices that have been provided on modern sterilizers, air can be removed, thus insuring the necessary penetration of the dress-

#### A SCIENTIFIC ANALYSIS OF STEAM IN STERILIZING

SHOWING HOW PRECISION METHODS MAY BE SUBSTITUTED FOR THE INDEFINITE METHODS NOW IN VOGUE

WEDDEN B. UNDERWOOD, Eng., Pennsylvania  
The greatest handicap encountered in establishing safe sterilizing systems is the heritage of misinformation about steam that has been handed down from the period of the introduction of steam sterilizers. Nurses have been taught to gauge sterilization by the inexact method of measurement of pressure rather than temperature.

The temperature of steam is the one bacteria destroying property. Pressure is only incidentally important. Steam is effective in sterilizing at relatively low temperatures by virtue of its moisture content. Saturated steam, as produced in the normal sterilizer, contains a definite amount of moisture. Its only variable factor with respect to its sterilizing properties is temperature. It is known that saturated steam at a temperature of 240 to 250 degrees F., corresponding to pure steam at 10 pounds pressure, will destroy all pathogenic organisms in a brief interval of time.

The relation of pressure to temperature in saturated steam is dependent upon the degree of air evacuation from the sterilizer. At 15 pounds pressure, the maximum temperature to be secured within the load is 230 degrees F., depending upon the degree of air evacuation. The pressure of air in the sterilizing chamber adversely affects sterilization in four distinct ways. The maximum possible temperature will be reduced, there will be radical variations in temperature in different parts of the chamber for an appreciable time, the time required to reach a uniform degree of temperature will be seriously prolonged, and the penetration power for a mixture of steam and air is less than that of pure steam.

Sterilizers operated by pressure without measured regard for air evacuation and resulting temperatures often become hazardous. The performance may be anything from excellent to very poor, but neither result is in the slightest degree indicated by the pressure gauge. Tests in hospitals show glaring inconsistencies. For example, a machine operated at 18 pounds pressure for 30 minutes developed a maximum temperature of 151 degrees F. A machine operated at 20 pounds pressure for one hour developed a maximum temperature of 220 degrees F. A machine operated at 20 to 29 pounds pressure for one hour developed a maximum temperature of 251 degrees F.

standing contributions to surgery, the development of the processes and technique of sterilization has been among the most important contributions to modern surgery. The work of surgery is largely dependent upon an abundant quantity of sterile surgical supplies. The slightest carelessness on the part of anyone who has to do with the preparation and handling of these surgical supplies may endanger the life of the patient and render the work of the most skilled surgeon of little avail. A rigid asepsis must be maintained from the time the patient enters the operating room until the surgical wound is healed and the patient discharged.

The sterilizing equipment of the hospital plays a most important part in producing and maintaining this necessary aseptic condition. For this reason the surgeon and his allied department have the right to insist that they be provided with the best and most efficient sterilizers that can be built to aid them in their important work of saving human lives. But the best sterilizers are not all that is required, for after such equipment has been secured, it is not only imperative that it be properly maintained, but also that it be promptly and effectively serviced by competent and efficient help.

The function of the sterilizer is to kill pathogenic bacteria. Its efficiency depends entirely upon the thoroughness and completeness with which this is done. The most effective way of destroying bacteria is by coagulation or solidifying the protoplasm of the cell. This is accomplished through the medium of heat, and it has been found, through laboratory experiments, that the degree of heat required will depend upon the conditions under which the heat is applied. An authoritative observer does not agree on the exact degree of heat required to kill the more resistant types of pathogenic bacteria. Their findings range from 230 degrees to 248 degrees F., this heat to be applied in the form of moist steam for a period of time ranging from 5 to 25 minutes. All will agree that the work of destruction will be effectively accomplished if the disease producing bacteria are subjected to a moist heat of 250 degrees F. for a period of at least 25 minutes. To insure a conservative margin, the pressure sterilizers should be operated for a period of 30 minutes under a steam pressure of 18 pounds, which will provide a moist heat of 255 degrees F. in the sterilizer chamber. This will give a temperature of 5 degrees higher, applied for a period of time 5 minutes longer than that recommended by the best authorities. Even this is a compromise, however, will not always guarantee a complete sterilization of the dressings. A moist heat of at least 250 degrees must thoroughly penetrate to the center of the packs and be maintained there for the required period of time. Unless this is accomplished, all germ life present will not be destroyed even though there is a temperature of 255 degrees in the sterilizer chamber. It is important to know that the proper temperature and moisture reach the center of the largest pack of dressings that is being sterilized. This can be assured by packing

Standardization of sterilizing procedures needs to include details of loading and preparation of supplies. Rarely are there two hospitals found using identical methods. Movement of air and steam within any sterilizer is always actuated by gravity, from the top toward the bottom, which fact has significant bearing on loading and preparation.

There is rather radical conflict of ideas relative to the requirements for sterilization, due probably to past inaccurate methods of gauging performance by pressure. Some authoritative body should clearly define limiting temperature and time factors, in order to bring about safe standardization and to accomplish practical, sensible reforms in sterilization procedures which will be less expensive.

#### OBSERVATIONS ON STERILIZATION OF DRESSINGS WITH SPECIFIC REFERENCE TO STERILIZING CHAMBER TEMPERATURES AND THEIR RELATION TO STERILIZER CHART TEMPERATURES AND CULTURES

S. R. D. HEWITT, M.D., and LYLA C. BELDING, R.N., St. John New Brunswick. One year ago we began a study of our sterilizing practices, mainly with the idea of establishing a relationship between the temperature as recorded on the steam and pressure chart of each sterilizer, and the actual temperature as recorded by a reliable thermometer in various locations within the sterilizing chamber, more specifically within bundles in the center of drum, center of ordinary bundles in solutions, gloves, powder, etc.

We observed that by preliminary heating of the sterilizer that is the steam jacket for a few minutes before proceeding with the development of vacuum and actual sterilization, it was relatively a simple matter to produce regularly a vacuum of approximately 15 inches. The vacuum was more rapidly obtained and what is more important more completely obtained by the preliminary heating. Our sterilizers are inspected every day by our chief engineer and all screens are cleaned not less frequently than once daily.

The minimum sterilizing temperature of 255 degrees F. required by our procedure was not reached within the bundle in the center of the drum in all instances until after 30 minutes had elapsed. What was recorded for this interval held good for all subsequent intervals up to and including 60 minutes. Theoretically, therefore, our temperature chart would lead the unwary to believe that the goods to be sterilized were exposed to our required temperature for an hour. Actually, we have satisfied ourselves that it requires the lapse of one half hour before that required temperature is reached in all instances.

From the observations made in 686 temperature studies, 616 of which were submitted to our pathological department for bacteriological study, we feel justified in arriving at the following conclusions: (1) we have satisfied ourselves that our sterilization practices are eminently safe; (2) we believe that we can obtain more complete vacuum by preliminary

heating of the jacket; (3) we believe it should be possible to reduce the time required for our sterilizing procedures; (4) there is a fairly considerable and consistent discrepancy between the thermometer, intra-drum, bundle, etc. temperatures and the temperature on the steam chart in the majority of instances, during the early periods of sterilization; (5) we are unable to satisfy ourselves that there is any method as safe and accurate as that of utilizing a thermometer within bundles; (6) there is a very definite irregularity of behavior of steam penetration, under identical conditions so far as we can produce them. For example, of the intra-drum temperatures reported at sterilizing level, by thermometer, there is a spread of 19 degrees, one bundle showing 235 degrees, another bundle 254 degrees. At 20 minutes, just taking this interval as an example, we find that this group study did not, relatively speaking, do as well from the temperature standpoint as those studied at 15 minutes. As expected, the discrepancies gradually became less, until at the end of 30 minutes, speaking of drums again, our final records show only a difference of 2 or 3 minutes.

#### CHECKING AND CONTROLLING POSTOPERATIVE INFECTIONS

HAROLD L. FOSS, M.D., Danville, Pennsylvania. Some form of complication accompanies a certain number of all surgical operations in the best of our hospitals even when the most modern technique is used. However, such complications should be kept at an irreducible minimum. Possibly even with the greatest care, 5 per cent of operations will be followed by some complication.

Of all complications approximately two thirds have to do with the wounds themselves. Fortunately, most are innocuous and are the result of contamination with the ordinary skin cocci. A high percentage of wound infections following clean operations is inexcusable. Catgut plays a certain role, but relatively few complications are the result of infection introduced by the suture material alone.

Most postoperative wound complications result from actual breaks in surgical technique, the types and varieties of which are legion. Some of the more common are insufficient sterilization of instruments, gloves and gowns; insufficient preparation of the hands of surgeons and nurses; carelessness on the part of the surgeons or nurses in the handling prior to coming to the operating room of infected material—all too frequently infection is transmitted as the result of unintentional carelessness in matters of personal hygiene. Sporadic occurrences of wound complications resulting from infection with the hemolytic streptococcus are frequently traceable to certain members of the operating room personnel who are carriers and who constantly harbor the organisms in their upper air passages. A careful masking of the mouth and nose of each person in the operating room will eliminate this source of infection.

The incidence of postoperative wound infections varies according to the location of the operating

ing forces in personality. May not psychiatry have something to give to a better understanding of the patient in the surgical ward where we see at work the forces of fear and loneliness and bitterness which have been called retrogressions of spiritual growth? I believe that both psychiatry and religion should have something to contribute to these problems.

It is the psychic shock in surgical experience that would seem to need exploration. At least we may be- come more skillful in preparing the patient who for the first time faces the startling experience in the hospital ward and operating room which to us are so very familiar and congenial. Surgeons often state that their skill is to give nature freedom to do her mysterious work of repair. The patient must of course be the one who must finally struggle through the personal problems. Collectively, may we not attain finer methods of freeing the patient to make more satisfactory repair of the psychic wound? May we look forward to the time when evaluation of end- results will cover not only the physical findings and the functional capacity, such as are noted in the end- sider the capacity of the patient to carry on in his human relations? I realize that personality and this serves to emphasize the necessity for more earnest consideration of the problem.

#### EXPERIENCE WITH A HOSPITAL FOR PEOPLE OF MODERATE MEANS

MORGAN J. KNEES, M.D., Boston. The Baker Memorial, the department of the Massachusetts General Hospital for patients of moderate means, has now been in operation for 4½ years. An increas- ing number of patients has been cared for each year.

- 1 The offering of moderate rates for bed care and for special services in a hospital unit large enough to facilitate economical administration.
- 2 Co operation with the medical staff whereby moderate fees are charged for professional services of all financial dealings with the patient under the hospital administration so that the patient is not presented with two or more independent bills for hospital and professional care, respectively, but with a single bill collected by the hospital, which in turn passes over to the physician his agreed fee.
- 4 An endeavor to minimize the amount and cost of special nursing.
- 5 An effort to provide all the service at cost, without charity and without profit.

The rates charged for board and other services are designed to cover the costs, with the building occu- pied to about two-thirds of capacity. A sufficient number of floor nurses is provided so that special nursing is seldom necessary and is allowed only if a patient needs more care than can be given by the floor.

Practice in the Baker Memorial is limited to mem- bers of the staff of the Massachusetts General Hospi-

room. For example, on the ground floor it will be relatively high, while on the top floor it will be relatively low. It likewise varies according to the degree of scrupulous cleanliness with which the room is kept, the number of people in the room, and the extent of disturbance.

Every well conducted hospital should have a care- ful record of postoperative wound complications, particu- larly a list of postoperative wound complications and infections. If they occur consistently with a fre- quency above the normal or irregular minimum, the fact should be made known immediately to the superintendent, the chief of staff, or some individual in authority whose duty it should be to take steps to correct the evil. Furthermore, every operating room employee and every surgeon operating in the institu- tion should be constantly aware of the presence of such a record and should be willing and ready, when ever the incidence of trouble with operative wounds is excessive, to institute a thorough investigation with the object of improving conditions promptly. A surgeon who regularly has a high incidence of in- fected wounds following operations performed on "clean cases" should not be long tolerated in the modern hospital, and by the same token the super- intendent who, being aware of an abnormal incidence of wound infections on a certain service, does not think about it, should be replaced by someone more conscientious and competent. Civilization has ad- vanced too far to permit such laxity. The "clean" surgical patient has a right to expect a clean hospital, operation, a clean postoperative wound.

#### SOME SOCIAL AND PERSONAL PROBLEMS OF SURGICAL PATIENTS

IDA M. CANRON, Boston. Medical social workers, whose professional function is concentrated on the patient as a person and on his human relationships, wish that it might be made clearer to surgeons that our interest includes not only the surgical end result, but more especially what is happening after the surgical end results are dismissed from attention. We believe that the patient would bene- fit from more satisfactory co operation between surgery and the relation of character and personality to the experience of sickness has always been a subject of interest to social workers. We have considered that our service was primarily concerned with "char- acter under adversity," and that sickness and pain and facing death and prolonging crippling disease brought special tests of character.

We are hearing increasingly these days of the in- troduction of psychiatry into the general hospital, the purpose of which is better understanding not only of functional disease but also of the functional factor so often present in organic disease. The con- tribution of psychiatry to medicine is only beginning to be appreciated, or at least so it seems to many of us social workers who are turning to psychiatry for deeper insight into human motives and the conflict-

tal and the Massachusetts Eye and Ear Infirmary. The staff has agreed to a schedule of limited professional fees, with a maximum of \$150 regardless of the length of stay or number of physicians involved. The hospital undertakes to see that only patients of moderate means who cannot afford to pay higher fees are admitted. Of 100 consecutive admissions the average income was \$2,272.80 per cent had incomes less than \$3,000. 54 per cent less than \$2,000. Requests for admissions from people with incomes less than moderate are much more numerous than from those who might be considered as well to do. Ninety-seven per cent of the patients are referred to the hospitals by members of the staff, only 3 per cent come directly from other doctors.

The Baker Memorial has not yet become self-supporting. It is hoped that it will be when occupied to about two thirds of capacity. The first 4 years had a deficit averaging \$63,000 a year. For the first 3 years the Julius Rosenwald Fund agreed to pay half the deficit. The balance and the entire deficit after the third year must be carried by the charitable funds of the Massachusetts General Hospital. In 1934 there has been a greater occupancy and a smaller deficit. The coincidence of increased occupancy with increased business activity would seem to indicate that with economic recovery the Baker Memorial will be able to pay its way.

#### A TRIAL OF THE EIGHT HOUR DAY FOR HOSPITAL SPECIAL NURSES

SALLY JOHNSON, R.N. Boston. A review of a trial period of the 8 hour day for hospital special nurses was made during the 5 months. May through September 1934 at the Massachusetts General Hospital and the Massachusetts Eye and Ear Infirmary. A comparison with 1933 was difficult as the necessary data were not recorded but based upon the statistics which were available the following statements are of interest.

During the trial period there was a daily average in the two institutions combined of 731 patients. The number of calls for special nurses which were filled was 3,778. The morning period of service is from 7:00 a.m. to 3:00 p.m., the evening from 3:00 p.m. to 11:00 p.m., the night from 11:00 p.m. to 7:00 a.m. The charge for each period is \$4.50 to the nurse, and 25 cents to the hospital for each of two meals, making a total cost to the patient of \$15 for 24 hours of service. Under the new system, the hospital itself has thus far not added to its personnel. The changes in cost to the patient with the 8 hour plan were reported to be as follows: General Hospital, average ward patient who was specialied, an increase of \$16.05 per patient per month (part of the increase in 1934 was due to the special apparatus required for several patients in for long periods of special care), Phillips House (private pavilion), increase per patient of \$8.50 per month, private pavilion of Eye and Ear Infirmary, increase per patient \$7.78 per month, Baker Memorial (for persons of moderate means), a decrease per patient of \$1.08 per month.

In reply to a questionnaire sent to the 3 groups most vitally concerned, 125 nurses gave unanimous approval of the 8 hour day, of 100 physicians, 6 reserved an expression of opinion, 13 did not approve, 6 approved with minor reservations, 75 fully approved. 250 patients replied as follows—12 had no basis for comparison, 26 disapproved, 212 approved without reservation. The data of comparative earnings and days of employment seem to indicate an increase in both figures. However, it must be remembered that few nurses had accurate figures for 1933, so that the number of studies was small, and that a nurse now has to pay for one meal daily which formerly was furnished.

Reliable records of the employment of individual nurses show that the 8 hour day has brought spread of employment. At the Baker Memorial, during a period of 5 months in 1933 149 nurses were employed, while during the comparable number of months in 1934, 238 nurses were employed. There was some increase in the daily census of patients, but not sufficient to produce this spread of employment. In the Phillips House during 5 months of 1933, 180 nurses were employed, during the comparable 5 months in 1934, 225 were employed. The daily census was only slightly higher in 1934. In the general hospital in 1933 122 nurses were employed during the 5 months, during the comparable 5 months of 1934 193 nurses had employment. There was practically no change in the daily census of patients.

Based on 18 years of interviewing prospective applicants to schools of nursing, I am of the opinion that an 8 hour day for hospital special nurses will do much to reduce the parents' objections to nursing as a vocation for their daughters. I believe that this change will bring more young women who possess integrity of character, an acceptable social background, attributes of desirable personality, and a higher level of education to the profession of nursing. Any plan which will tend to accomplish this result is worthy of serious consideration for it will improve nursing from the standpoint of the hospital of the nurse of the physician and of the patient.

#### HOW I, AS A HOSPITAL TRUSTEE, VIEW MY RESPONSIBILITY

IDA M. CANNON, Boston. The first duty of a trustee is to accept as the central purpose of the hospital the skilled and ready care of the sick and injured. In so far as the hospital provides an opportunity for education of internes and nurses, this educational function should be secondary to the care of the patient. It is a happy fact that the higher the quality of consideration and care of the patient the better will be the basis for good teaching of doctors and nurses. The trustee must be interested in listening to any serious complaints about service. The sympathetic hearing of such complaints often results in the issue disappearing into thin air, explanations can often be made that disarm the critic. If there is ground for complaint the duty of the trustee is to express gratitude for having the situation brought to



official attention and to make every effort to have it corrected

Next to obligation to the patient is loyalty to the professional groups within the hospital. There should be respect for each position in the organization. There should be scrupulous care not to undermine the authority of those placed in positions of authority and responsibility. Deference is due the professional groups when questions concerning professional service are brought to the board of trustees for consideration.

Community relations should be of special concern to the trustees. It should be remembered that in accepting the appointment of trustee one is not only a special representative and interpreter of the hospital to the community, but also a special representative of the community to the hospital. There should be a sensitive interest in a program for the hospital that will take into account the changing needs of the community. There should be a feeling of responsibility for keeping abreast of the most progressive thought concerning hospital administration.

The position of a hospital trustee is one of those elastic responsibilities that cannot be measured in hours of service. The board is invariably made up of busy people who must fit this extra service into already crowded hours. It therefore rests with each trustee to see the full scope of the responsibility accepted by the group making up the board of trustees. Within that joint responsibility there is the obligation on each trustee to see what special contribution he can make so that collectively there may be within the board an integration of special contributions.

#### HOW I, AS A HOSPITAL PRESIDENT, DISCHARGE MY DUTIES

FUTLER BARNES, Bristol, Connecticut I have always felt that experience is one of the best teachers and that the president of a hospital, if he is at all actively, must necessarily have an intelligent knowledge of all departments and of as much of the work as possible. Each year in our institution the trustees appoint 8 members to an executive committee, 5 laymen and 3 doctors. The medical and surgical staffs, which are well organized, nominate 3 of their own members to this committee each year. The executive committee meets once every month with the superintendent and takes an active interest in seeing that the various departments function effectively. This relieves the president of much work and is an ideal situation from his standpoint. There is a separate committee for the training school, of which the president is chairman.

#### HOW I, AS A TRUSTEE, JUDGE THE EFFICIENCY OF OUR HOSPITAL

I-VERSOLO BOWDITCH, Boston The trustees are responsible for the policies of the hospital, if they allow the superintendent or the staff to dictate these policies efficiency will be decreased. Trustees may be sure that their hospital is not lacking in efficiency if it is approved by the American College of Surgeons, approved for membership by the American Medical Association, and its school of nursing approved by the State Board of Registration. In studying the efficiency of a hospital the book-keeping department is an excellent place to start. The daily record of patients will give an idea of whether the doctors are making use of hospital facilities. The treasurer's monthly statements will show if expenses are being met. Statistics from the

work through them in whatever questions may arise. He must not delegate too much to his subordinates and should not permit problems which should be settled to remain unsettled. The president must maintain a capable and friendly organization in which all committees and employes work together in close harmony so that no problems are allowed to get beyond control.

Having delegated authority, whether to a committee, the superintendent, or an employe, the president should never go over their heads, but work through them in whatever questions may arise. He must not delegate too much to his subordinates and should not permit problems which should be settled to remain unsettled. The president must maintain a capable and friendly organization in which all committees and employes work together in close harmony so that no problems are allowed to get beyond control.

I consider it the duty of every active president to visit his hospital at least once every 10 days, often if possible, to talk over current events with the superintendent, who appreciates moral support and a close sympathetic understanding. While visiting the hospital I endeavor to call on as many patients as possible, and talk with the nurses and doctors in an effort to maintain the spirit of co operation and friendliness which is so essential.

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record room files will reveal many important facts. A trustee may learn what the mortality is in maternal cases and what percentage of patients are being discharged "relieved or not relieved." Another good place to check efficiency is in the boiler room. This can be under the supervision, in addition to that of the superintendent, of a trustee who has a technical knowledge of how boilers should be fired.

Doctors are generally very free in their criticisms of the way a hospital is run and by talking with them informally a great deal can be learned. At least once a year at my hospital the medical and surgical staffs meet with the trustees and are given an opportunity to make suggestions. At least one member of the staff is on the executive committee and he is able to keep the committee informed as to how the doctors feel in respect to the efficiency of the hospital.

It is a good plan to place each trustee on a different committee so that he can come into contact with special activities. The monthly meetings are made more interesting by the reports from each trustee who is able to impart knowledge concerning a specific department.

An excellent way to learn whether a hospital is filling the needs of a community is by reading letters written to the superintendent by patients who have been discharged. Another means is by judging the type of internes. If a hospital can get internes who were graduated near the head of their class at medical school it is safe to say that the institution will be efficient.

If a trustee is willing to give the time he can easily learn whether his hospital is being run efficiently not only by attending the trustees' meetings but by visiting the hospital at various times, day or night, by being on friendly terms with the doctors and all those who are connected with the hospital from the superintendent to the orderly and by being a member of at least one committee of the trustees. The more you know about your hospital the more pleasure you get out of being a trustee.

#### TUMOR CLINIC RECORDS

JAMES T. NIX, M.D., New Orleans. It is possible that the solution of the cancer problem rests with the tumor clinic record. To be adequate it is essential that the record have completeness and accuracy coupled with simplicity. Long questionnaires are undesirable because they lack flexibility, that is adaptability to the individual case. They tend to stress form rather than content and make for perfunctory stereotyped mediocre records. Nevertheless there are certain necessary points of information which must be contained routinely and unless furnished on the printed page these points may easily be overlooked and neglected much to the detriment of the record. Uniformity and standardization are therefore desirable and necessary but they must be tempered with sufficient elasticity to preserve the individual features of every case.

The following is an outline of an adequate tumor clinic record.

- 1 General identification data, advantageously assembled on a printed page.

- 2 Summary sheet, serving as a guide to the remainder of the folio and intended to furnish the essential points in the case record at one glance.

- 3 Statistical form containing information abstracted from the record and tabulated for the purposes of clinical research.

- 4 Complete history and record of physical examination at the time of the first visit to the clinic as exhaustive and personal as those taken in a surgical or medical service.

- 5 Reports of all roentgen ray studies with the corresponding plate numbers.

- 6 Record of all clinical laboratory examinations, especially the Wassermann reaction and hemograms.

- 7 Reports of the pathological department on tissue sections either from biopsy or operative specimens, or both with the dates and corresponding slide and specimen numbers.

- 8 Graphic information including photographs in chronological order, photomicrographs whenever possible and diagrams made to scale of the lesion and the region affected.

- 9 Social service information.

- 10 Record of the treatment instituted, whether surgery, or radiation or a combination of both.

- 11 Follow up records, embracing the progress notes made by members of the medical staff at the patient's periodic visits to the clinic and entries made on the record by the social worker.

- 12 Miscellaneous including the various "release forms" employed at different hospitals.

Two points deserve special emphasis—the need for complete radiation records and the value of good graphic sheets. X-ray and radium treatment sheets must have complete information. They should have a diagram of the part and lesion radiated showing the actual position of radiant foci in addition to a statement of the method and the type of radiation employed, the type of container, and its strength, and the filter used, the duration of exposure, the surface dose and size of the tumor and distance from the skin.

#### THE USE OF THE NATIONAL NOMENCLATURE

H. B. LOGIE, M.D., New York. While hospital staffs are exhorted to keep adequate records in order that they may be approved, the ultimate purpose of record keeping is not just approval but the promotion of mutual instruction and self education. Before the hospital record system can be perfected and attain its proper importance, the attitude of the hospital physician in writing case histories must be altered.

The wholesome principle of the *Standard Nomenclature of Disease* is the point of view illustrated on every page that disease is a process, not a thing. Adherence to this principle preaches in its quiet way

coupled with a proficiency in shorthand and typing is preferable. The minimum requirements should be set at 2 years of college training and should include a foreign language, preferably Latin. With this background the student should be not less than 21 years of age. She should be required to present a certificate of good health. The make up of her character and personality should be studied for a sufficient length of time through observation, and her recommendations examined closely, to ascertain whether she possesses the necessary poise and other essentials. Upon completion of the course the student should be required to pass with credit a comprehensive examination prepared by the Board of Registration of the Association of Record Librarians. The length of the course should be a period of not less than 6 months, 8 months is preferable. Instructors must be selected with extraordinary care and have at least the same educational background expected of the student, coupled, of course, with the advantages in experience which practical application during a period of service has given. The time of such experience has been set at not less than 5 years of actual hospital work. A person should be endowed with a convincing forcefulness and a dignified earnestness in order to qualify as an instructor, for only to the extent to which she possesses such characteristics can she be assured of gaining the confidence and respect of her students.

Hospitals in which the student is to receive training may be divided into two classes. First, those connected with universities which can give the educational background at the same time that the student is being given practical experience. Second, those which without a university connection will give the practical training to the student who is already equipped with the necessary educational qualifications.

Any hospital applying for the privilege of training students should be a general hospital with a capacity of not less than 250 beds. It should have an out-patient department, an accredited intern service, a school of nursing, a social service department, and, most important of all, it must possess all the standard facilities required by the American Hospital Association, the American Medical Association, and the American College of Surgeons. The hospital should charge a reasonable tuition or fee for the training and should not treat the student as an apprentice, but provide her with sufficient closely supervised, practical work to permit the actual application of classroom theory.

Thus, we are endeavoring to establish a new milestone in the progress of our profession, to lift it to the plane its importance justifies, and to create standards which will assure its continued development and expansion as a necessary collateral branch of the medical arts. It is our sincere hope and wish that we find a co-operative, tolerant attitude on the part of all our associates, and that through such co-operation our efforts may lead to the favorable results which our sincerity of purpose warrants.

which constitute the morbid process. It tends to dignify the process of diagnosing and naming diseases, since names take on a live meaning when they are chosen only after a clear and logical process of clinical thinking. Between the lines of the *Nomenclature* is the constant exhortation to the clinician to define his case completely in clinical terms, and the warning is there that the names of the specialties of disease are not diagnoses. Moreover, the clinician finds that many of his pet terms are either cloaks for ignorance or merely partial diagnoses, and therefore not diagnostic at all. Here, then, is a task for the thinking man, and not a disagreeable duty to be relegated to the most immature of the hospital's physicians or even to lay employees. The question two years ago was whether physicians would shift the added responsibility or would respond to the challenge. The answer can now be given. Diagnoses are so much more comprehensive and complete in many of the hospitals using the *Nomenclature* that were it not for the speed and accuracy of the coding system, record rooms would have difficulty keeping pace with them. Cases are diagnosed more fully, and the record of the hospital's experience is kept more faithfully, not because of rules and regulations, but because the physicians wish them so. This, then, is the foundation upon which the National Conference has come to build that clinical thinking is at the root of all medical practice, diagnosis, therapeutic, and prognostic, and that the improvement of any hospital depends in large measure upon how fully its physicians realize that the record of its successes and errors and failures, and of the mark of advancing medicine in its practice, must be an open book for those who write its history and those who follow.

The National Conference on Nomenclature of Disease in the beginning contemplated only a nomenclature comprehensive enough to serve as a national standard. It soon learned, however, that nothing but the most accurate possible classification of diseases would serve as a standard for all, and that the system to be set up must be adaptable to an accurate, complete, and readily usable system of record keeping. So far as has been possible, the best medical thought in this country, and to some extent in other countries, has been put at the disposal of the Conference. The Conference has been compelled to hew as closely as possible to the line of clinical accuracy. Moreover, had it not determined at the outset that the nomenclature was to be clinical and not merely anatomical or physiological, it would have been compelled by the physiological forces to adopt this broader view of disease.

BASIC PRINCIPLES IN THE TRAINING OF RECORD LIBRARIANS

Jessie N HARVED, Rochester, New York. In addition to suitable personality, which is most essential, a record librarian must have the proper cultural and educational prerequisites. College training

# ORGANIZATION AND MANAGEMENT OF A MEDICAL RECORDS DEPARTMENT IN A SISTERS' HOSPITAL

Sister M. PATRICIA, O.S.B., B.S., Duluth. When the Standardization program of the American College of Surgeons began in 1918, a new era opened for all hospitals, and in a special sense, for hospitals under the management of the various religious Sisterhoods. It was with the spirit of their founder that the Sisters set about to comply with the requirements of the College. One of the most difficult requirements to be met was that accurate and complete records be written for all patients and filed in an accessible manner in the hospital.

A well organized medical records department should have a chart of organization. This includes the board of directors, superintendent, medical staff, medical records librarian assistants and at times student librarians. In institutions where student librarians are trained affiliation with some nearby college is necessary. Record librarians should hold membership in the Association of Record Librarians of North America.

The major functions of a records department are to contribute accurate data for the scientific study of disease by the staff and internes and consequently to improve the care of the sick. In conducting research records are essential. In the treatment of any given disease the records on that disease show what was done for the patient, the reason why it was done, and whether the method of treatment produced the best results possible. Records also give an analysis of the physicians' work in the hospital which information can be used in making appointments to the hospital staff. Staff meetings and pathological conferences could not be held without making use of records.

In our experience the best location for the records room is in the main line of passage. It should be centrally located because of the contact which the records librarian must have with all departments especially with the regular and visiting staff. It has been advised to place the department as near the staff room as possible because doctors will be likely to consult the records if they are within easy reach.

An efficient filing system is of importance to the hospital and to its medical work. There should be simplicity of arrangement, reference material should be easily accessible, and the scientific classification must be correct. The storage of records has been a problem in most of our hospitals because of the difficulty in finding a place where the charts can be conveniently and safely kept. The unit system has been acclaimed the best system of numbering and filing records. In the operation of the unit system a designated person should be available during the night to look up charts of previous hospitalization.

The sooner a record is written after the patient is admitted the greater its accuracy. The supervision of records should also begin as early as possible. Some hospitals use a check system whereby the charts are inspected daily by the personnel of the

records department, and deficiencies noted on colored tags placed on the chart.

No chart is complete unless a follow up record of the case after the patient has left the hospital is included. It is not enough to file the record when the patient is discharged, one must follow him up for 1 or 2 years to ascertain if the diagnosis of his illness was correct and the treatment successful.

Finally, an efficient records department requires the efforts and interest of the entire hospital personnel.

## ROUND TABLE CONFERENCE PROBLEMS CONCERNED WITH CLINICAL RECORDS WITH SPECIAL DISCUSSION OF USES OF CLINICAL RECORDS

Conducted by ALLAN CRAIG, M.D., Torrington, Connecticut

The most outstanding of the many interesting problems relative to clinical records which were discussed at this conference were the following:

1. The prompt writing of records was unanimously voted as one of the difficulties in almost all hospitals. Several speakers emphasized the uselessness of records long delayed and the dangers of records written after the patient had left the hospital. This brought up the question of how far the hospital might go in enforcing record regulations. One hospital record librarian said that members of the staff had been suspended for carelessness in this respect but that they had returned with the honest attempt to comply with the regulations.

2. Should nurses be permitted to take case histories? This question naturally brought some division of opinion between the larger and the smaller institutions. It was however the consensus that case histories when taken by a nurse do not always reveal the true status of affairs either regarding family history or personal history, these being confidential matters between the physician and the patient. It was the general opinion that nurses should not be permitted to write case histories, and that the only person who should and could get a reliable history would be the physician or his assistant. This discussion brought out the necessity of ethical confidence not only in the writing of case records but also in their handling and in their reviews.

3. The use of case records for purposes of research and investigation was discussed at length. Should the physician be permitted to take the records from the hospital? Some of those present indicated that under special circumstances a physician should be permitted to take the records out of the hospital for the purpose of research or investigation or in order to prepare his cases for Fellowship in the American College of Surgeons or the American College of Physicians. It was the general consensus however that the records should not be removed from the hospital for any purpose except on subpoena of the court. It was also the majority view that the hospital should provide a place where physicians on the

Shortly after admission the patient is shaved and scrubbed, and an enema given unless contra indicated for any reason. As termination of labor approaches, the patient is brought to the delivery room and delivered under strictly aseptic conditions. The delivery suite, which includes a waiting room, is isolated from wards and corridors.

Nothing but aseptic towels and draperies are used in the waiting and delivery rooms, thus keeping them in a highly aseptic condition. When patients are nursing babies they are obliged to use masks so as to prevent transmission of respiratory infection from mother to baby. Patients after being transferred to the wards are given instructions about danger of infection, and are cautioned about handling or contaminating the parts or carrying infection from below to nipples and breast by the fingers. Routine care is given to vaginal and rectal section especially after bowel movements. Vulva pads are used but left loose so as not to back up lochia. The breasts are watched with care, particularly the nipples, for cracks, and between nipples are covered with sterile waxed paper, as a result of this constant watchfulness we are happy to report that for many years we have not had a breast abscess. We use the rotating nursery method, and all maternal such as crib coverings, babies' clothing, etc., is changed frequently and nothing but sterile linen used. If any patient runs a temperature of more than 99 degrees for more than 48 hours, she is automatically transferred to the isolation ward. We have been fortunate in having no sepsis for some years, and our mortality rate is very low. As another safeguard, visitors are scrutinized as much as possible, and, if to be using a handkerchief for cough, the dangers are explained and they are asked not to visit. At all nurses are watched for any type of infection. Nurses and internes in the obstetrical delivery room are those who have already had their operating room training. During the training year all nurses are given special courses by the staff on obstetrical and gynecological subjects.

#### CASE OF EMERGENCIES

CONVULSUS I O'LEARY, M D, Boston Being situated in a district through which some of the main arteries of travel pass into the city, and being within easy range of a number of small industrial plants, St Elizabeth's Hospital has a busy accident department. We are prepared to handle accidents during all hours of the day or night. The department is in charge of one of the Sisters who is a trained nurse. To assist her she always has one or more of the student nurses.

When the accident case arrives the patient is taken at once into a room immediately adjoining the admittance door. The house officer, whose sole work during a period of 3 months is to handle accident cases, is summoned at once. We have a rotating system for our internes at the hospital, and they

staff might review records without taking them out of the institution. The question of whether or not the records department should assist physicians and surgeons in preparing their records for the College of Physicians and College of Surgeons was discussed, and it was decided that every assistance possible should be rendered these men, and that the records should be typewritten. However, the physicians should make some arrangement with the records department of the hospital for carrying out this part of the work.

4 The permission of one physician to review the records of another was discussed. It was thought by some that the physician should obtain not only the permission of the physician who wrote the record but also the permission of the patient. In reviewing surgical papers, it was felt that this would handicap the physician writing the paper, and if the name of the patient were not revealed, the consent of the physician would be sufficient.

#### OBSTETRICAL DEPARTMENT IN A GENERAL

##### HOSPITAL

CHARLES J KIRKMAN, M D, Boston The ma-

ternity department in St Elizabeth's Hospital is segregated on one floor which contains wards and nurseries, as well as delivery, admissions, and isolation rooms. None but a maternity patient is ever admitted to this department even though the maternity beds may be in great part unoccupied and although other departments are turning away patients for lack of available space.

Our obstetrical staff consists of a chief, three senior and three junior obstetricians, and a house interne who while on obstetrical service is not permitted to attend any other type of patient. The house number from the prenatal clinic comprises a large number of the admissions, but any member of the hospital staff may send patients for delivery, thus the actual care and delivery of cases in our obstetrical department are distributed among a fairly large group of men.

Upon admission patients are sent to the admitting room, if they are prenatal cases their record is sent up from the clinic. Complications, such as kidney or cardiac disease, are given special attention, but if no complications are noted our routine is to keep these patients in the waiting room during their labor period, here a general physical examination is made and recorded on admission, the nurse records blood pressure, pulse, duration and interval of labor pains, rupture or non-rupture of membranes, any bleeding or abnormal vaginal discharge, action of the fetal heart, and effects of any pre-delivery sedatives which have been ordered. Particular attention is paid to the fetal heart, record of which is taken as a routine every half hour or hour, depending upon the stage of labor. Rectal examinations are made on admission and at intervals and handlings recorded. No vaginal examinations are made except upon special order.

take charge of the accident service only after completing all their other services, the interne in charge of this department is always well trained.

If the accident is slight the interne himself cares for it—always, however giving orders for the patient's return on the following morning at which time the visiting surgeon sees him and approves what the interne has done or institutes such other treatment as may be necessary.

If the accident is severe the visiting house surgeon is summoned at once. The arrangement at our hospital is for 6 surgeons to take 2 months each on house cases. During the time of their house service they are also on service for serious accidents. When the surgeon has viewed the patient he admits him to the hospital if he believes such procedure necessary. Fracture cases, if severe are referred to the orthopedic department.

In all cases of severe head injuries patients are shaved at once. Regardless of the findings the patient is advised to remain in the hospital for a period of at least 24 hours. Having specialists in eye, ear, nose and throat work, all of whom are not far from the institution and who are expected to respond at once to any urgent call from the hospital we are prepared to take care of such cases under the guidance of skillful doctors.

No operative work is done in the accident room nor are blood transfusions given there. Our operating rooms under 24 hour supervision of graduate nurses are so near at hand that the patient can be transferred thereto without any loss of time if major operative work is necessary. Everything required for emergency work in such cases as drownings, asphyxiations, monoxide poisonings and the like, are to be found right at hand in the accident room. With such arrangement and equipment we have no difficulty in successfully treating the large number of emergency cases which we are called upon to handle.

#### OUT PATIENT DEPARTMENT

REV THOMAS J. BRENNAN, Boston. I have been unable to determine historically the genesis of the out patient department. Probably someone in the vicinity of a hospital who was in need dropped in and asked if some doctor would see him, which request was very charitably granted. Others hearing of the service probably did likewise and soon the hospital saw the desirability of establishing such a service for the needy. This is merely a theoretical explanation.

The organization of the out patient department at St. Elizabeth's follows along the lines of out patient departments in general hospitals. More than 17,000 patients were treated in this department during the past year.

To cite an editorial from the current *Medical Digest* which discussed an article entitled 'The Plight of the Doctor.' "It is now customary even in hospitals maintained by public and private con-

tributions, to make small charges for medical service in the so called free clinics. But it has never become customary for the doctor to be paid for his work in these clinics. Once a free patient, always a free patient. Doctors have observed that they rarely ever are visited again by a patient after that patient has acquired the free clinic habit. Most of those who first entered free clinics because of the economic depression never again will patronize their family doctor."

It is the duty of the hospital to protect the doctor from unworthy cases—those who dishonestly abuse the service of the free clinic. While good social service departments can do much in this matter, there are always hidden resources which even these departments cannot investigate. Would it not then be a good idea to make each patient coming to the free clinic bring a letter from a local physician stating that the case is a worthy one? In this way the physician would at least have an opportunity to offer free care to the patient, and he may even be remunerated at a much later date. Under present arrangements he is denied this opportunity.

#### MATERNAL CARE

A series of practical demonstrations on maternal care supplemented by motion pictures, was conducted at the Boston Lying In Hospital by LOUISE S. ZUTTER, R.N., superintendent, and heads of departments. The program embraced the following features:

'Admission of Patient to Clinic' ERMINE CONZA, R.N. 'Physical Examination of Patient' HAROLD M. TEEL, M.D. 'Care of Patient in Labor, Care of Patient in Delivery Room, Immediate Post Partum Care' ETHEL STEWART, R.N., and assistants. 'Care of Newborn Formula Room,' BERNICE DENIGORD, R.N. 'Care of Premature Infant' DOROTHY SOLOMON, R.N. 'Care of Post Partum Patient,' EDITH CARPENTER, R.N. 'Care of Isolated or Septic Patient' FLORENCE BOSTOCK, R.N. 'Post Partum Clinic,' FLORENCE SWANSON, R.N.

A round table conference was conducted by ROBERT JOLLY, Houston superintendent, Memorial Hospital, and president American Hospital Association on Administration, Professional, and Economic Problems, which constituted a clearing house for all questions arising out of the deliberations of the previous sessions in addition to a special program of fifty important hospital questions.

Demonstrations and round table discussions in hospital standardization and administration were conducted at the Beth Israel Hospital by CHARLES F. WILINSKY, M.D., director, and heads of departments including the following: 'The Training of Internes in the Social Aspects of Illness' ETHEL COHEN. 'Food of Hospital Patients,' MANLYA MOORE. 'Some Nursing Problems in a General Hospital,' JOSEPHINE A. MULVILLE, R.N. 'Applications of Business Principles in the Management of Hospitals,' CHARLES F. WILINSKY, M.D.



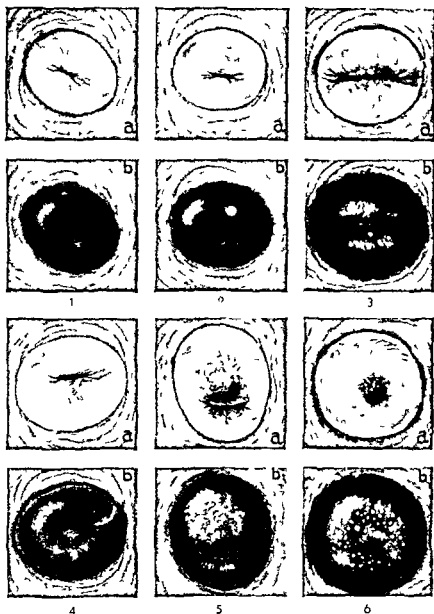


Plate I. Lohm Schiller test. *a* Before the application of Lugol's solution. *b* after the application. These reproductions were drawn at the time of the test and the colors carefully checked.

- 1 Normal cervix
- 2 Multiparous cervix with a nabothian like follicle. (See Figs 17 and 18)
- 3 Lacerated cervix with early carcinoma on the posterior lip. (See Figs 14

15 and 16)

- 4 Multiparous cervix with small ring of erosion and prominent scar
- 5 Multiparous cervix with marked by

hypertrophy of the anterior lip and erosion with some eversion

- 6 Multiparous cervix with diffuse spotting of leucoplakic plaques and eversion



# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME 60

MARCH, 1935

NUMBER 3

## PRECANCEROUS AND CARCINOID LESIONS OF THE CERVIX UTERI

WITH COMMENTS ON THE SCHILLER TEST

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IN the great majority of cases, the diagnosis of carcinoma is simple enough, either clinically or pathologically, and microscopic examination is only confirmatory. In the early and "borderline" cases, however, the microscope must play the decisive role. To wage an effective fight against cancer, moreover, we must not only be familiar with the characteristics of early cancer, but we must learn something more about lesions now loosely spoken of as "precancerous." This term was first used by Dubreuilh in 1896 and has been widely adopted. It is undoubtedly a good descriptive term if applied, as it should be, only to those processes which may, but do not necessarily, become malignant. It should not be construed as indicating that the lesion in question represents the preliminary stages of cancer, though it is quite possible that some of them do. As long as we do not know the cause of cancer, a study of these lesions and of their possibly malignant potentialities offers a new and fertile field for the gynecological pathologist and may be expected to yield much in the way of early treatment and prophylaxis of cancer.

We have recently completed a study of material from the cervixes of 50 individuals who have been treated conservatively in our department, in an endeavor to correlate as accurately as possible the histological picture and the subsequent clinical course. Microscopically the cervixes all showed evidence of increased cellular activity, i.e., mitoses, hyperchromatosis, polymorpha, and hyperplasia of the basal layer, without, however, any evidence of invasion. Indeed, all the cytological characteristics of cancer were in evidence, except epithelial heterotopia. Recent examinations have shown, in spite of the cancer-like cell changes in the original lesions, no tendency to the subsequent development of cancer.

*Normal cervix* The accepted description of the normal histological picture of the cervix varies so markedly that it is difficult to obtain sections of the epithelium conforming to the textbook descriptions. The distinction between the three accepted strata is definite. The basal layer has a picket-fence appearance with an undisturbed nuclear polarity. Mitoses and hyperchromatosis are more frequently present than most observers have noted, but these are merely suggestive of expected natural cellular changes necessary for the processes of growth and repair.

The thickness of the epithelial layer is apparently independent of the age of the adult patient, and we have noticed no constant histological changes in the pregnant cervix. Inflammatory processes seem to alter the basal layer, bringing about an apparently increased cellular activity. Hot douches, cauterizations, and local therapy also produce a distorted histological picture (Fig. 2).

**Metaplasia** The value of serial sections of biopsy material is fully demonstrated in cases of so called "metaplasia" or "epidermization." Though in some instances the cytological changes resulting from the inflammatory lesions do present a perplexing picture, the cellular activity in some of the chronically infected cervixes has frequently led to erroneous interpretations and probably accounts for some so called 5 year cures. In most instances the benign invasion by the squamous epithelium is innocuous in appearance and in no way resembles the ruthless invasion of the malignant growth. Cell nests and columns of squamous cells (Fig 3) apparently lying free of surface attachment, may tend to confuse the picture. A full appreciation of the mechanism of this process simplifies its interpretation and lessens the probability of errors in diagnosis. The individual cells in most instances display none of the characteristic cytological features associated with malignancy. The round cell infiltration is also less marked though this reaction is far from dependable. Mitoses and hyperchromatosis are not uncommon and not infrequently the changes are so marked as to suggest a cancerous process.

That in the majority of cases so called metaplasia is not a precursor of cancer is accepted. However the presence of this process does imply a chronic irritation and conservative corrective therapy is indicated. Without

doubt a few of these lesions do develop into malignant processes, but it is not possible with our present information to differentiate the ones that will remain benign from those possessing malignant potentialities.

**Leucoplasia** Hinselmann's work with the colposcope has revived our interest in the leucoplasia like changes in the cervical epithelium and has also created a new field for possible diagnostic errors. Simple curetting of the cervix for microscopical study, as originally suggested by Schiller, does not yield sufficient tissue for the diagnosis of this process, as the individual cellular changes may too closely simulate the cells of cancer. Again, the value of serial sectioning of biopsy specimen is to be emphasized.

The process develops most frequently at the site of transition between the squamous and columnar epithelium though it is not rare to find the entire cervix sprinkled (Plate I, Fig 6) with the small white or grayish white plaques. Microscopically the epithelium is more compact and varies in thickness. There is decided basal layer hyperplasia with changes in the nuclear polarity. Mitoses may be of both the normal and the pathological types though they may be very sparse. The subepithelial round cell response also varies and may at times be entirely lacking. We have not noticed the subepithelial hyalinization which is so commonly seen in leucoplastic processes elsewhere. In those cases with marked stromal reaction it is frequently difficult to trace the basal line and the presence of invasive tendencies may be simulated. As Schiller has shown, there is usually a sharp transition from the normal epithelium to the area of leucoplasia. This line of demarcation is also prominent in other conditions as we shall describe later. Leucoplasia elsewhere is considered genuinely a precancerous lesion, but whether this applies to the cervix is certainly debatable, the histological criterion accepted by some include changes characteristic of definite malignancy, except that invasion is not present. Several observers claim to have observed cases in which cancer has developed within an area previously shown to be leucoplastic. We have not been fortunate enough to encounter any similar instances.



Fig 1 From a 19 year old nullipara (Plate I Fig 1). The three strata are well defined and the basal line is intact with equal nuclear polarity. No stromal reaction.

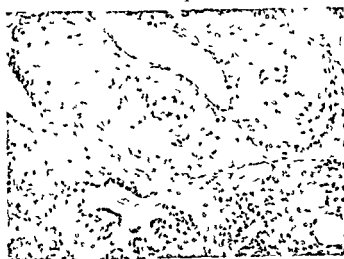


Fig 3

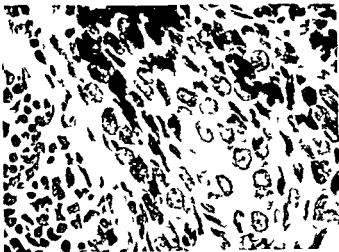


Fig 5

Fig 4 The epidermatization process has replaced the cylindrical elements in an orderly fashion, except at one point there is an apparent break in the basal membrane. Fig 5 High power of figure 4 showing increased cellular activity with mitoses, many hyperchromatic nuclei, and no definite limiting layer. Six years after the biopsy was taken the patient shows no evidence of cancer.

small plaques were present just within what was formerly the external os. Following the application of the iodine solution, the two plaques on the anterior lip showed some absorption of the iodine and, microscopically, a local epithelial hypertrophy. The small plaque on the posterior lip, however, did not absorb the iodine and stood out sharply against the mahogany background. Biopsy was not performed, as an interposition operation with small malignant growth measuring 1 millimeter in diameter and originating in an area



Fig 2



Fig 4

Fig 2 An unusual abrupt change between the loosely packed squamous layer on one side and a more compact layer. This differs from the transitional line in certain other conditions in that it is vertical. This patient had received a prolonged course of local therapy to the cervix. Fig 3 Benign epidermatization with nests of squamous cells, rare mitoses, and no suggestion of malignancy.

However, we do believe that the present evidence is insufficient to place this lesion in the same class, as regards cancer potentiality, with the leucoplasia found elsewhere. *Carcinoma* Whether or not the metaplastic and leucoplastic processes of the cervix are likely to develop into true cancer is undecided. And yet we do not feel justified in permitting certain lesions to remain untreated because of scientific interest in their future course. The following case shows that carcinoma, here a basal cell type, may develop in metaplastic areas. The cervix (Plate I, Fig 3) was deeply lacerated, with a duck-bill appearance, three



Fig 6 Changes in the cervical canal depicting the columnar elements replaced by squamous cells. Beneath the pale normal appearing cells is noted the increasingly broad layer of darker stained cells. This layer supplants the paler cells entirely and assumes an appearance suggesting cancerous activity.

of definite metaplasia. This patient is being examined each month and as yet has shown no tendency to recurrence.

*Other interesting cervical lesions.* So far as we know the microscopical cervical changes in the 2 following cases have received little or no attention in the literature. In 1912 Bowen described similar changes in the skin in an article titled "Precancerous Dermatoses, Chronic Atypical Epithelial Proliferation" and the skin lesion described is accepted by most dermatologists as Bowen's disease. The



Fig 7 High power showing the marked cellular changes. Mitoses and hyperchromatosis are frequent. This patient shows no evidence of cancer after a period of 18 months has elapsed.

acceptance of this as a nosological entity from the standpoint of etiology and pathogenesis is still debated as is its relationship to the so-called extramammary Paget's disease. Though the histological changes in our cases do not altogether fulfill the cytological criteria specified by Bowen, Darier, Jessner, and others, the similarity is striking enough to bear comparison.

**CASE 1 (Plate I, Fig 2)** In October 1933, a 24 year old negress was examined for vaginal bleeding later found to be the result of endometrial hyperplasia. Inspection of the cervix revealed a small cyst like area on the anterior lip suggestive of an



Fig 8 Biopsy from a cervix of a 45 year old woman with proclutia of 2 years standing. Marked thickening of the squamous layer with metaplasia. The basal layer shows definite hyperplasia, increased compactness of the strata and increased cellular activity with abundant stromal infiltration.



Fig 9 Higher power showing atypical mitoses with polymorpha and hyperchromatosis. The cervix was amputated following an interposition operation and 4 years after this operation had been performed there is no change present which might be regarded as suggestive of cancer.

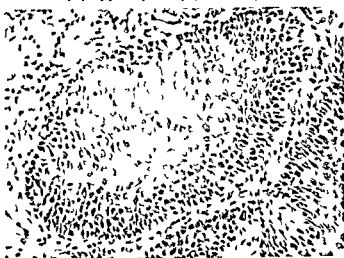


Fig. 11 High power of the epidermal bud shows many mitotic figures, however, the entire picture is that of a benign process with increased cellular activity.

CASE 2 There is no evidence of invasion in either of these cases. The relative lack of stromal reaction, with the edema and hyalinization in the second case, removes this lesion from the category of accepted cancer. The true nature of this lesion is not known, are we dealing with an unusual form of cancer or of leucoplasia, or a pro cancer with a new pathologic and clinical entity? Two cases are not enough to warrant conclusions as to their true etiology or pathogenesis. We are following with interest the first case, which was treated conservatively, but unfortunately a panhysterectomy was performed on the second case.

*Intra-cervical carcinoma* Though not an instance of early malignancy, we have included the following case not only to illustrate the value of the Schiller test in some cases, but

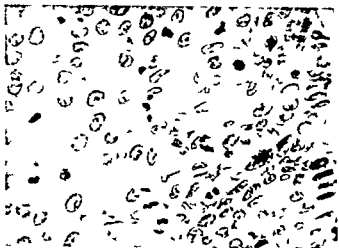


Fig. 13 High power showing both normal and pathological mitoses. There is also a moderate polymorphia. The stromal reaction is not marked. The patient on recent examination shows no tendency to cervical cancer.



Fig. 10 A specimen removed from the anterior lip of the cervix in 1929. There is no evidence of cancer on recent examination. This is definitely of the leucoplasic group showing epidermal thickening, increased compactness of the basal and transitional layers. Several small epidermal buds seemingly lying free of surface attachments are the result of angular sectioning. There is no evidence of invasion.

ordinary nabothian cyst. However, the iodine was not absorbed as readily as expected and the biopsy showed changes suggesting early malignancy, with perplexing cellular changes. Radical measures were deemed unnecessary, as it was thought that the entire growth was included in the biopsy. The location of the area was also considered to speak against malignant growth, as the accepted site of predilection for both cancer and leucoplasia is near the external os, or at the junction of the squamous and columnar cell layers.

This case is being carefully watched in our out patient department and at a recent examination shows no recurrence of the white areas, and the cervix has always readily absorbed the iodine.

Fig. 12 Section of a polyp removed in 1929 showing marked basal hyperplasia with all the cellular changes characteristic of cancer. However, invasion has not taken place.

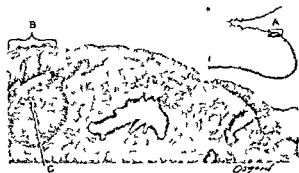


Fig 14 The line of transition between the squamous cells in the more normal epithelium and the carcinomatous area is sharp and clearly demonstrates the mode of malignant extension

also because of the unusual nature of the malignant extension

**CASE LE.** A 60 year old negress was registered with the complaint of vaginal bleeding of 3 weeks duration. At examination there was no apparent bleeding and the pelvis was essentially of the normal senile type. On inspection the cervix was found to be smooth and firm with a wide velvet red margin about the external os which did not bleed following manipulation. This was interpreted as a typical erosion. A cotton swab passed up into the cervical canal did not elicit bleeding. Following the application of the iodine solution a small grayish white plaque about 2 millimeters in diameter was noted at the right lower angle. A biopsy specimen showed a slight thickening of the epithelial layer with a small area sharply demarcated from the more

normal appearing tissue and strongly suggestive of leucoplacia. One small nest of squamous cells, however, made us suspicious of malignancy, though various observers differed and some considered it benign. In view of the patient's history of post menopausal bleeding, age, and the suggestive microscopical picture, a panhysterectomy was advised.

#### LAHM SCHILLER TEST

It was noted by Lahm in 1927 that the portio vaginalis of the cervix displayed certain absorptive qualities following the application of Lugol's iodine solution. The chemical basis for this absorptive ability has been attributed to the presence of a glycogen like substance in the cells of the spiral layer of the cervical epithelium. The clinical value of the test was further elaborated by Schiller, following a thorough study of different lesions and their reactions. However, the correct interpretation of the test is not a matter of simplicity as there are many modifying factors present even in the normal cervix, and many that may serve to confuse the final picture.

In the crowded out patient department the application of the iodine solution with a sponge is not only time consuming but exceedingly inconvenient. To overcome this disadvantage we use a bulb atomizer, with the cervix well exposed and clean it is relatively simple to spray the entire cervix under direct vision. The excess solution is removed with the speculum following the examination.

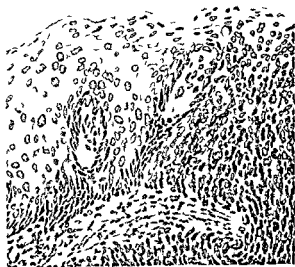


Fig 15 Higher power drawing of B in Figure 14 showing more clearly the cellular differences between the two zones

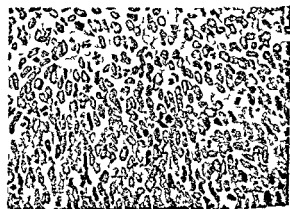


Fig 16 High power drawing of C in Figure 14. Giant cells are also present but are more numerous in the surface area. This is the earliest definite carcinoma of the cervix we have seen and is of special interest in that it appears in an area of metaplasia commonly regarded as benign.



Fig 17 An oval epidermal bud with marked keratinic asymmetrical division, peculiar clumping of the nuclei, and vacuolization of the cells. There is a moderate parakeratosis with nuclei broken up into very small fragments. A few large cells with numerous large nuclear fragments can be seen scattered through the entire epidermal surface. The picture is suggestive of those changes associated with arsenical keratoses and is not dissimilar to roentgen ray dermatitis.

Previous digital examination with an oiled or soaped glove will tend to confuse the picture. When the cervix is covered with blood or discharge, spraying the cervix with a moderately strong solution of potassium permanganate and carefully wiping with a soft wet sponge is sufficient to ensure a clean surface. Care must be exercised in manipulation so as not to traumatize the cervical epithelium, thus removing the glycogen-containing cells and distorting the picture. The normal surface of the pars vaginalis absorbs the iodine evenly and assumes a dark mahogany color. Nabothian follicles, as a rule, also absorb readily, but not infrequently stain to a lesser extent. In case of eversion with the columnar epithelium presenting, the stain is not absorbed by the everted mucosa and the color is a pinkish red (Plate I, Fig 6). This is disappointing, as the test is thus of no value in cases of adenocarcinoma. However, this type of growth is relatively infrequent, occurring only in 1 of 25 cases in our series.

The areas of erosion vary in relation to the intensity of the inflammatory reaction (Plate I, Fig 5). The more acute the inflammatory process, the deeper the absorption, as the leukocytes, rich in glycogen, readily take up the iodine.

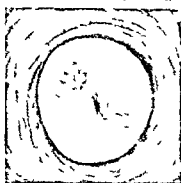
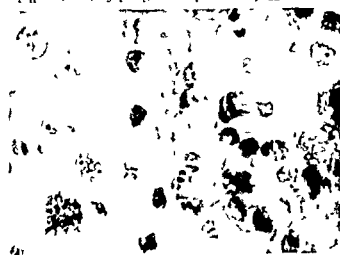


Fig 19 Small grayish white elevated plaque not unlike the preceding case in location and gross appearance. The pitted area is the site of the biopsy.

Fig 18 High power showing the definite intracellular edema and hyalinization, parakeratosis, hyperkeratosis, multinucleated giant cells with clumped nuclei, and a few pathological mitoses. There is no evidence of an invasive tendency and the cells are for the most part embryonal in character.



We have recently noticed certain variations in the pregnant cervix. In three young primigravidae in the early months of pregnancy, and with cervixes normal in appearance, the iodine was absorbed readily in two instances and taken up very lightly in the third. This was repeated a number of times with the same result each time. Biopsy failed to reveal any histological clue for this variability. We have also noted in apparently normal cervixes following supravaginal hysterectomies that some of the cervixes fail to absorb as readily as before the operation.

As a rule, the areas of metaplasia do absorb the iodine, as do cases of advanced malignancy, in which there is a marked secondary infection. With late cases having suspicious nodules in the vaginal vault, the application

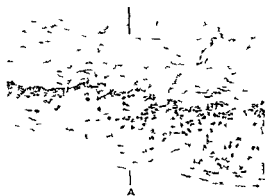


Fig 20 The biopsy specimen showing an edematous subepithelial layer with hyalinization which is not uncommon in leucoplacia elsewhere in the body also a scant round cell reaction The transition between the obviously normal epithelium and the abnormal area is not as marked in this drawing as in Figure 22 but the transition in the stroma is surprisingly sharp and extends through the entire area of the process

of the iodine may serve to outline the areas of malignant extension

Leucoplacic areas are occasionally visible without the aid of the iodine test as small white or grayish white plaques But these vary from day to day in their gross appearance and whether this chameleon like ability affects the absorptive power is not known However we have observed several cases in which the histological picture was that of typical leuco-



Fig 22 Photomicrograph of the end of the lesion opposite that pictured in Figure 20 There is the characteristic oblique transition between the normal and the abnormal layers The subepithelial edema is apparent but the hyalinization is not as clear The large vacuolated multinucleated cells with the pale web like cytoplasm is interpreted by some pathologists as belonging to the Paget cell group

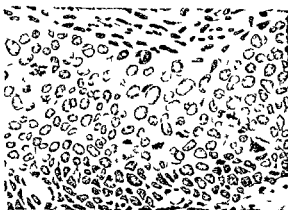


Fig 23 High power drawing from the center of the process illustrating the peculiarly large giant like cells with pathological appearing mitotic figures the intracellular edema and keratinization This latter is more apparent in Figure 23 There are also a few abnormal mitoses The intracellular edema alone differentiates this process from extramammary Paget's disease where intercellular edema is present with the large characteristic Paget cells

placia, while the gross picture, even with the aid of the iodine was negative

Small areas of carcinoma of the squamous cell type present a picture identical with that of leucoplacia so that the test is not specific for malignancy but serves rather as an aid in selecting the site for biopsy

Though this test is routinely applied to every patient in our dispensary and fully 25 per cent of the cases have been checked histologically we do not at all feel that it is infallible The use of the colposcope as advised by Hinselmann and others does magnify the gross picture but with good exposure and

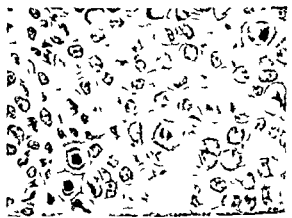


Fig 23 Higher power to illustrate the intracellular edema and keratinization which is especially marked in this case



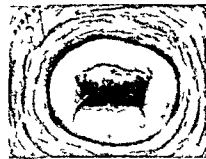


Fig. 24 Normal appearing senile cervix with typical erosion about the external os, the biopsy site at the lower right angle. On gross examination of the cervix after the removal of the specimen there was no suggestion of cancer.

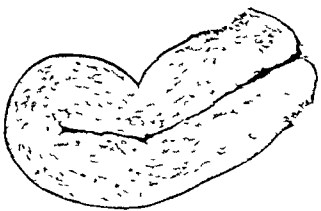


Fig. 25 Longitudinal section through the uterus, showing a definite well circumscribed intracervical carcinoma with the canal relatively free of the usual friable projections commonly present in malignancies of the cervix. Extending from the primary growth in the cervix is a thin layer of cancer of the squamous cell type which covers the culture endometrial surface, but does not extend out into the tubes.

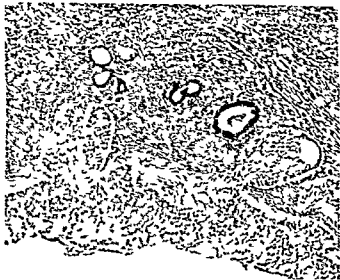
the tumor growth occurs is a moot point, there is no proof that the growth is accelerated, and animal experiments show no change in the growth rate following trauma. Neither have we noted any infections following the biopsy, either with the punch forceps or with the scalpel. Three days after taking a biopsy from a normal cervix the wound is usually completely healed. In most cases the site of biopsy is touched with phenol or silver nitrate. Hemorrhage, except in advanced cases, rarely occurs, and at most amounts to only a slight

# BIOPSIES

In view of the admitted difficulties in the microscopical diagnosis of early carcinoma of the cervix, the amount of tissue for study must be sufficient to include not only the suspected area, but also some of the apparently normal tissue. For satisfactory interpretation of the histological picture an aggregate view of the changes must be obtained. Diagnosis is based on the individual cellular changes is hazardous especially when the tissue is scant in amount. One section from the area in doubt frequently misses the suspected process, while serial sections of the specimen will not uncommonly reveal the real nature of the lesion. We have been impressed with this on many occasions, and routinely follow this procedure.

The dangers of infection, dissemination or stimulation of the tumor growth, and hemorrhages are apparently not as dangerous as they were once considered by many. In spite of any possible risks, the data obtained more than counterbalances them. That stimulation of

Fig. 26 Low power drawing showing the relation of the squamous cell cancer spreading like "cake frosting" (canal type) over the entire endometrial surface, the endometrial glands are of the senile type. The growth has not invaded the myometrium.



venous ooze. An important factor in taking the biopsy is immediate fixation, for it has been shown that the alkaline secretions of the cervix bring about a definite fading of the nuclear particles and thus the resultant microscopical picture is hazy. Immediate freezing and staining is the ideal method but when permanent serial sections are desired from a small bit of tissue this procedure is difficult and undependable except in the hands of an expert.

The divergence of opinion as to the diagnosis in very early carcinoma of the cervix is disheartening; many still seem to cling to the older concepts of cellular confusion so characteristic of the late stages. At the other extreme are those who scent malignancy wherever there is a departure from the accepted normal of cellular activity. In order to appreciate fully the pathology of the cervix one must be especially equipped to diagnose the very early case. To attain this knowledge one must possess a familiarity with all the various cellular changes, checked by careful follow up studies in each case. Merely to call the changes suspicious or doubtfully malignant is of little aid to the clinician who wishes to be informed that the lesion is either benign or malignant. If the pathologist can not decide either way, the responsibility reverts to the clinician though when such doubt exists the wise plan is often to defer active treatment until the question can be definitely settled for such a slight delay will rarely endanger the patient.

#### SUMMARY AND CONCLUSIONS

The microscopic diagnosis of cervical cancer will not be improved until both the clinician and the pathologist learn more about such pseudomalignant and possible pro-malignant lesions of the cervix as have been discussed.

Mitotic figures are occasionally seen in the basal layer of the normal cervical epithelium and are to be looked upon as evidence of the normal growth and repair of the cervix.

Cervical lesions may be spoken of as "pre-cancerous" when it is understood that the term implies they might though not necessarily become cancerous. The microscopical picture of these lesions is less perplexing if the mechanism of development is understood. That cancer does originate in the so-called metaplasias is illustrated by 1 case.

Leucoplacia of the cervix is a pathological entity which may show cellular changes suggestive of cancer, though invasion is always lacking.

Two cases showing microscopical changes similar to both Bowen's disease and extra-mammary Paget's disease, a condition rarely if ever described in the cervix.

An interesting case is described of intra-cervical carcinoma diagnosed with the aid of the Schiller test and in which the malignant growth extended over the entire endometrial surface of the uterus.

The importance of biopsy is indisputable but its value is increased if the specimen is immediately fixed and serial sections are made. Serial sections are of especial importance in cases of suspected early cancer.

The application of Lugol's solution with the atomizer simplifies the test. The Schiller test is undoubtedly of some value in the diagnosis of early cancer, whether it is a specific for the absence of the cancer is questionable.

To Dr. Thomas S. Cullen and Dr. Emil Novak we acknowledge with sincere gratitude our indebtedness for the valuable assistance in the preparation of this paper. We also wish to express our gratitude to Mr. Milton Kough for the splendid photomicrographs, to Mr. Leon Schlossberg for the colored plate and to Mr. M. D. Destinch and Mr. J. O. Osgood for the drawings.

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FULMINANT SINUS DISEASE

STUDY OF THE PATHOGENESIS<sup>1</sup>

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THE nose with its accessory nasal sinuses is capable of giving rise to interesting and formidable pictures indicative of local and general disease. Acute osteomyelitis of the maxilla, especially in infants, occurs with sufficient frequency to lead to considerable theorizing as to its etiology and therapy. In studying the complicating factors and sequelae of this condition we have tried to trace the ways by which it becomes associated with acute suppuration of the accessory sinuses of the nose.

The literature is replete with case reports of fulminant nasal sinus involvement, in these the various complications, the possible etiological factors, and the treatment applicable in each instance are discussed. The majority of reports name thrombophlebitis as the usual route of extension and stress conservatism in treatment. The autopsy material has been surprisingly meager, clinical evidence or biopsy specimens were usually taken as final sections made through the head of an infant. We were fortunately able to study, serially, 3 weeks of age, who, as the history indicates, developed a fulminating sinus infection manifested by external swellings about the face and associated with a concealed thrombus in the cavernous sinus. Even without the history, a careful study of the histological series would make it quite possible to trace in chronological order the entire course of the disease.

CLINICOPATHOLOGICAL FEATURES  
OF FULMINANT SINUS DISEASE

Fulminating sinus disease always has been considered a formidable condition because of the anatomical relationship between the sinuses and the surrounding structures. Endocranial, auricular, ocular, dental, and systemic involvement may result from extension of sinus infections. In speaking of a fulminating type of sinus infection, the writer refers to sinus disease which manifests itself by swellings about the face, osseous involvement, and

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Fig 1. Characteristic external findings of edema of the lids, one in an infant and the other in a 9 year old. Both responded to conservative therapy. These cases represent the experience usually encountered.

nose may extend to the sinus by way of the angular vein whereas those in the interior of the nose and sinuses go through the ethmoidal veins. Such a case from my clinic was recently reported. In this instance a bilateral cavernous sinus thrombosis developed following a submucous resection of the nasal septum (7). Infected foci in the superior maxilla may spread by way of the pterygoid plexus. The anastomotic venous radicles also permit infection to be transmitted between these different channels. Caries and inflammatory erosion of bone (osteoclasia) may result from extreme pressure by inflammatory products or these products may cause a separation of the bone from its mucous membrane and mucoperiosteum.

Purulent inflammation of the nose especially during influenza or any of the acute infectious fevers may cause a reaction of the tissue which interferes with the normal ventilation of the sinuses. There may be anatomical obstructions or there may be swollen turbinates impinging upon the septum even though the nose gives little evidence of inflammation shows no bulging of the wall of the nasal cavity and maintains a free flow of secretion. Usually it is the ethmoid sinuses that are involved although a pansinusitis on the same side may occur. The ethmoid cells are well developed early in childhood and since acute upper respiratory tract infections are frequent involvement of these sinuses is by no means rare. In addition the vascular

and lymphatic development is greater in children than in adults (3). The mucosa becomes edematous and the underlying periosteum becomes infiltrated (periosteitis), the bone bleeds freely (osteitis) during operative intervention. The structures overlying or neighboring the bone may become swollen and the bone itself become sequestered (canes).

#### CLINICAL PICTURE

A unilateral swelling of the upper lid is characteristic of frontal involvement (in children past the age of 5 years) a swollen lower lid is associated with ethmoid cell disease or both lids may be swollen in a combined involvement (Fig 1). The lids become infiltrated (peri-orbital and orbital cellulitis) and occasionally the infection may localize and form an abscess (orbital abscess—Fig 2) or even break down to form a fistula (canes or necrosis—Fig 3). Similar swellings at first brawny and later soft, may occur over the frontal area and the cheek. Inflammation usually causes a thickening of the periosteum at the medial wall of the orbit leading to a red, painful swelling near the inner canthus of the eye. There may also be pain localized to the involved area or referred to other parts of the head. The temperature may vary from 98 to 103 degrees F. Strangely enough, one may find a violent external manifestation in an individual who is not acutely ill. Figure 4 shows a rather striking picture of objective inflammatory reaction, without much sub

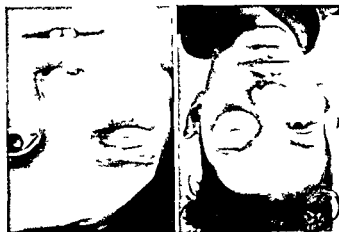


Fig. 2, left. An abscess of the lid which resulted from a periorbital cellulitis. This condition necessitated external drainage in addition to shuntage and intranasal drainage. Fig. 3. In this patient as the result of a caries with abscess formation a fistula from the floor of the frontal sinus occurred. An external approach with the removal of sequestered bone, when the acute process subsided led to a resolution of the process.



Fig. 4. A striking picture is presented by such a marked objective reaction, as shown in this case, without much subjective response. In this patient the appearance was even more exaggerated because of the application of incure of iodine to the forehead by the patient himself. The therapy in this instance, infiltration of the middle turbinate and irrigation of the frontal sinus, favorably influenced the picture within 48 hours.

ected in orbital complications that confirmed by X-ray was not considered necessary. The orbital cellulitis is considered by Babitt as a secondary manifestation of infection—a syndrome rather than an entity. The cases with early external orbital manifestations are thought by Barwich to run a more benign course than those without external symptoms. Approximately 75 per cent of orbital infections were secondary to disease of the nasal accessory sinuses, particularly the ethmoids, in a series of 60 cases reported by Porter. Eighty-two per cent of these were in children,



Fig. 5. Child, 3 weeks of age, showing a branny swelling of the left side of the face. The eyelids are reddened, and the outer canthus to the temporal area and to the cheek where the induration was also branny in character.

Saeger, reviewing 67 cases of orbital inflammation collected from the literature and one of his own, concluded that sinus disease is one of the most common causes of orbital inflammations in children. He quoted Coakley, Harke, Oppikof, Wertheim, and Wolff, as showing by autopsies that the sinuses of children may be readily involved. Others believe that children do not have the essential predisposition for rhinogenic orbital inflammation that adults have. Theisen, in a study of 31 cases from his service in an infants' hospital, found the sinuses so commonly af-

fective response. The eyeball itself may remain normal but occasionally becomes protruded, the bulbar and palpebral conjunctivae are decidedly chemotic. Motion of the eye may be limited owing to external rectus pares or impaired mobility of the extra-ocular muscles. When the ptosis becomes so great as to prevent the lids from covering the eye, corneal ulcers may form. The predilection for the maxilla is explained on the basis of its larger size, more rigid constitution, attachment to the skull—favoring a more frequent reception of trauma—and greater blood supply around areas of ossification. Unerrupted teeth represent areas of greater vulnerability, which may determine metastatic infection. Saeger, reviewing 67 cases of orbital inflammation collected from the literature and one of his own, concluded that sinus disease is one of the most common causes of orbital inflammations in children. He quoted Coakley, Harke, Oppikof, Wertheim, and Wolff, as showing by autopsies that the sinuses of children may be readily involved. Others believe that children do not have the essential predisposition for rhinogenic orbital inflammation that adults have. Theisen, in a study of 31 cases from his service in an infants' hospital, found the sinuses so commonly af-



Fig. 6 Frontal plane section in the region of the deciduous molar and the respiratory portion of the nose. *A* showing the breaking down of the mucosa below the inferior turbinate as though it had contained an abscess. *B* roof of the mouth in the region of the hard palate, and the area occupied by corpus adiposum buccae (Bichat). *C* between the masseter and external surface of the buccinator muscles. The antrum of Highmore *D* is filled with pus. The bony trabeculae surrounding the antrum are seen to be in considerable confusion, not adhering to the regular arrangement of the normal lamellar structure. The inferior turbinate *E* contains a well walled off abscess cavity. The large isthmus leading down into the mouth *F* is shown but in this section it appears to be connected merely with the abscess cavity in the cheek.

and of this number 7 per cent were directly due to abscessed teeth, 7 per cent to trauma and the rest attributed to miscellaneous causes. There was a mortality of 5 per cent in this series all of the deaths occurring among children under 2 years of age.

#### PATHOGENESIS

The relationship of osteomyelitis to diseases of the antrum invading the anterior portion of the cavernous sinus through the ophthalmic veins is discussed by Eagleton. He believes that when the infective process originates in the teeth it may occasion an acute osteomyelitis of the superior maxilla with involvement of the antrum, this rapidly perforates into the orbit and extends to the cavernous sinus. In these cases the infection travels not by continuity of tissue suppuration but by retrograde thrombosis, which later is the cause of the nutritional death (gangrene with sequestration) of the osseous parts. Ballenger (3) likewise believes that acute osteomyelitis of the superior maxilla may be secondary to

buccal infection, the involvement following an infection of the dental sac. The inference in such cases is that the infection originated in the tooth, from which a retrograde thrombophlebitis ascended, causing not only nutritional death of tissue with consequent bony necrosis of antrum and ethmoids, but also orbital abscess, and finally involvement of the cavernous sinus.

An associated acute osteomyelitis is the result of the venous infection—not the cause of it. Drainage of the associated orbital abscesses cannot possibly control the disease, since the infection has already invaded the cavernous sinus itself. The literature shows how invariably futile drainage operations have been performed on the orbit, the ethmoids, and maxillary antrum—futile because such drainage does not attack the thrombophlebitis itself. If these cases were diagnosed early it is possible that operation upon the thrombophlebitic veins would offer a fair prospect of recovery.

The clinical pictures of osteomyelitis of the maxilla in nurslings and infants have been variously described and many factors have been named as causes. The disease may set in during the first week or up to the ninth month of the infant's life, the greatest incidence is during the first 3 weeks after birth. Pathological manifestations of redness, swelling, purulent discharge, necrosis and sequestration may be present on any or all of the surfaces of the maxilla (orbital, nasal, facial and palatal).

Many cases of osteomyelitis of the jaw in infants are now on record and the subject has been extensively reviewed a number of times within recent years. It is unnecessary to consider in detail all of the various opinions that have been held for the pathogenesis of this disease. In early medical literature (12) cases of this type were presented as curiosities and were published as records of the early age at which empyema of the antrum may occur rather than as contributions to the pathogenesis of the disease. In 1904 Kelly called attention to Schmiegelow's paper which had appeared 8 years before in which the clinical manifestations were attributed to an acute osteomyelitis of the maxilla. Kelly collected 17

cases including his own, and concurred with the views of Schmiegolow. Since that time many theories have been advanced as to the causes of the osteomyelitis. The clinical pictures of all the cases on record are strikingly uniform, although the points of entry and method of spread of the invading organism are still matters of controversy. A resume of the various views that have been held is presented in the recent papers of Bass and Wilensky. Few of the cases reported have been studied histologically, and it has been difficult to determine accurately the mechanism of the disease complex solely by clinical study. The patients are too often seen after the pathological condition is well established and as a consequence the primary seat of the process can only be inferred. Deduction by inference is the favorite method of clinicians in the reports which appear in the literature. We ourselves have never felt certain of the pathogenesis in the cases of ours that have recovered (11).

We have attempted to reconstruct pathological processes from clinical and histological evidence obtained by preparing serial sections of the head of an infant who succumbed to

Fig 7. A vertical section in region of first permanent molar. The respiratory portion of the nose, A, with a break in the mucosa under the inferior turbinate indicating the rupture of an abscess. The palatal portion of the mouth indicates that a fistula has broken through the lower part of the maxillary sinus C and the tract, E, coursing downward, one part extending outward to a large abscess in the cheek, D, and the other progresses downward into the oral cavity, B. The facial wall of the sinus is completely destroyed and the presence of bone spicules is found. The zygomatic wall of the antrum as well as the root of the zygoma, F, has been destroyed.



an osteomyelitis of the maxilla (Fig 16). It appears that many possibilities are present following a nasal infection. Dogmatic statements have been made by proponents of each mode of invasion to account for the osteomyelitic process. Svoboda and Zarb favor the theory of inflammation of the toothpulp in the course of sepsis of the newborn. This hypothesis does not fit in with the clinical history or the pathology in the majority of the cases reported in the literature. In his most recent publication on the subject, Zarb discusses the process as a necrotizing inflammation of the deciduous teeth. After an exhaustive histological study, he points out that the purulent inflammation does not begin in the tooth anlage itself but in the surrounding tissues and that involvement of the tooth anlage is secondary. On the basis of clinical and histological findings he divided his cases into two types: (1) phlegmonous and (2) osteomyelitic, according to whether the soft parts or the bone were primarily involved. He presents differences in the clinical course that correlate with the underlying pathological picture. The final cause of the disease is the entrance of organisms into the soft parts or bone marrow of the jaw. The infection spreads from an inflammatory focus in the region of the jaw or from a distant focus. The cases Zarb grouped under the phlegmonous type had circumscribed foci (erysipelas-

Fig 8. Frontal section through first permanent molar, I. The facial wall of the maxillary sinus is completely destroyed and a large fistulous tract containing spicules of bone, leading into the abscess in the fat pad of the cheek, B, and also finger-like projections reaching down into the tooth germ. (This photomicrograph is reversed but still concerns the same left side.)



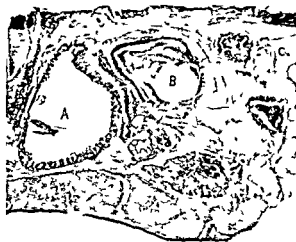


Fig 9 Section through the posterior choana 4 showing the large abscess which has extended into the pterygoid fossa B There are two smaller abscesses in the region of the maxillary division of the fifth nerve C and a broken down area immediately below the lateral wall of the nasal cavity

of the face and stomatitis) the infective process extending to the jaw by way of the lymph channels In the osteomyelitic type there was a spread through the blood stream from a distant focus such as would result from a furuncle

According to Wilensky osteomyelitis of the maxilla differs in no way from osteomyelitis in general The localization in the jaws in nurslings is due to such traumatic factors as those incident to childbirth cleansing of the mouth etc The position of the thrombophlebitis governs the site of the necrotic process It is Wilensky's belief that the local clinical manifestations in the maxilla are determined by the dominating position of the thrombophlebitis in the vascular channels supplying the jaws

From careful evaluation of the case reports and data on the subject of osteomyelitis of the maxilla in infants it appears that the portal of entry and the method of spread of the primary infection may be variable The fact that the entire tooth germ is sometimes exfoliated through the draining sinuses does not mean that the tooth anlagen were the original sites of the pathology or that they are especially liable to such involvement It does not mean that the structures supporting them have been destroyed In our case,

despite the marked necrosis, the tooth pulps withstood the destruction remarkably well

The phase brought out in the study of this case is that nasal infection and sinusitis must be considered as a possible primary cause in osteomyelitis of the maxilla in infants It has been suggested through the clinical reports in the literature that such etiological factors are frequently present but the fact that the sinuses are incompletely developed in infancy has obscured their significance The maxillary sinuses and ethmoidal cells are always sufficiently advanced in their development at birth to be of clinical importance and the microscopical studies in the present case makes their importance fully evident It would seem therefore, that nasal infection and sinusitis should receive more serious consideration when the pathogenesis of osteomyelitis of the maxilla in infants is studied

#### REPORT OF CASE

Osteomyelitis of the maxilla in an infant following a purulent rhinitis producing an ascending and descending abscess formation and a cavernous sinus thrombosis

R B a white male infant 3 weeks of age, was admitted to the Research and Educational Hospital The mother stated that 9 days prior to admission, the infant had a thick yellow nasal discharge The infant was restless and refused to nurse Fever was not present at this time Two days later the nasal discharge became thin and mucoid in character and coincident with this the left eye became reddened and a swelling appeared on the upper eyelid In the next 24 hours the lower eyelid became swollen Forty eight hours later the child was taken to a doctor who found a point of swelling on the left upper gum margin The next day there was a spontaneous discharge of thick bloody purulent material from the left nostril This was followed by a progressive decrease in swelling about the eyelids The day before admittance the infant developed several small fluctuant areas on the left cheek near the outer canthus of the left eye and the lids again became edematous Because of this the patient was brought to the hospital and admitted to the Pediatric Service The mother believes that the infant has been without fever throughout the entire course of the illness The patient was the second child of healthy parents The mother had a normal, spontaneous delivery The immediate neonatal history was normal and the patient did well until the time of the present illness

*Physical examination* The patient was a fairly well nourished infant He did not appear acutely ill or toxic but was restless and irritable No eruptions or lesions were present on the surface of the





Fig. 10 Vertical section through the central region of the sphenoid. On the lateral wall of the sphenoid, is a cartilaginous projection which is the lamina medialis of the nasal cavity. The body of the lesser wing of the sphenoid, the lesser wing of the sphenoid, and the greater wing of the sphenoid (Fig. 10) In the pterygoid fossa there is a small abscess and there are septal thrombi in a number of the adjacent veins. In a section anterior to the posterior wall of the pharynx, including the body of the

Fig. 10 Vertical section through the central region of the sphenoid. On the lateral wall of the sphenoid, is a cartilaginous projection which is the lamina medialis of the nasal cavity. The body of the lesser wing of the sphenoid, the lesser wing of the sphenoid, and the greater wing of the sphenoid (Fig. 10) In the pterygoid fossa there is a small abscess and there are septal thrombi in a number of the adjacent veins. In a section anterior to the posterior wall of the pharynx, including the body of the

soft tissues covering the tips of the enamel cusps and incisal edges of the deciduous teeth. Each dental analage showed a sufficient pad of soft tissue between the oral epithelium and the tooth crown, precluding the possibility of any postnatal lacera- tion or exposure of the tooth germ. It is quite evident that the involvement of the inferior turbi- nate is considerably older than that seen in the other regions of either the maxilla or mandible. These findings strongly suggest that the original infection was in the nasal cavity.

The frontal section through the plane of the permanent molar region, reveals that the facial wall of the sinus is completely destroyed. A large fistu- lous tract, containing spicules of exfoliated bone is seen to lead into the abscesses of the cheek, and a finger like projection reaches downward, external to the tooth germ (Fig. 8) The zygomatic process of the antrum is seen to be destroyed with an exten- sion of the phlegmonous process into the pterygo- maxillary fossa. There are two smaller abscesses in the immediate vicinity of the maxillary division of the peristome of the lateral wall of the nasal cavity (Fig. 9) Sections were studied through the

of the inferior turbinate bone and also an involvement of the maxillary sinus which is much more recent (Fig. 6) shows an old extensive osteomyelitic process section through the plane of the deciduous molar accordance with the clinical symptoms. The frontal closed microscopical changes which were entirely in the histological sections dis- laborated in by Dr Poncher and myself (13) Dr Blaney of our Dental Department and col- pneumonia was revealed as the cause of death. A

body. Positive physical findings were confined to the head. The left side of the face was prominent. The left eyelid was reddened, edematous and almost closed. The edema of the eyelids extended beyond the outer canthus of the left eye almost to the tem- poral region. The left cheek and mandible were swollen and soft. The overlying skin had a faint purplish red color (Fig. 5). A scant amount of seropurulent material drained from the inner canthus of the left eye. The same type of discharge exuded from the left nostril and reappeared rapidly when wiped away. Pressure over the left maxilla increased the discharge from the left nostril. Upon rhino- scopic examination the material was seen to origi- nate from below the inferior turbinate. The right nostril was clear. The left alveolar margin was swollen and boggy, and a fistulous opening was pres- ent in the region of the first molar tooth. A thick yellow discharge drained from this area and was increased in quantity by pressure over the left maxilla. The pharynx was diffusely hyperemic throughout. The entire group of cervical lymph nodes on the left side was enlarged and firm to touch.

The urine was negative, examination of the blood showed haemoglobin, 68 per cent (Newcomer), red blood cells, 2,970,000, white blood cells, 13,650. The differential blood count revealed 49 per cent poly- morphonuclears, 47 per cent lymphocytes, 3.5 per cent monocytes, and 0.5 per cent eosinophiles. Cul- ture of the discharge from the left side of the nose, eye and the alveolar fistula revealed Staphylococcus aureus.

The child's temperature on entrance was 99 de- grees F but rose progressively in 4 days to 103 degrees F. Coincident with this rise there was an increase in the swelling and fluctuation of the areas described. A few fistulae developed on the left side of the face just lateral to the outer canthus of the left eye. The cervical swelling increased, extending upward to the zygoma. The patient failed to re- spond to supportive measures and died 6 days after entrance.

Postmortem examination. A terminal broncho- pneumonia was revealed as the cause of death. A special histological study of the head was begun by Dr Blaney of our Dental Department and col- laborated in by Dr Poncher and myself (13) The histological sections dis-



Fig. 11 Section at the level of the uvula the body of the sphenoid the sphenoidal fissure and the greater wing of the sphenoid The posterior pharynx *A* and pharyngeal space including the tonsil *B* are normal but the abscess *C* in the muscle planes shows much destruction of surrounding parts and septic thrombi in the nearby veins The abscess is located in close proximity to the eustachian tube

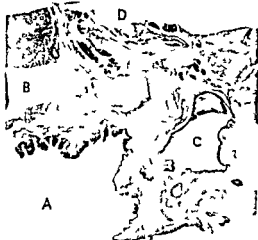


Fig. 12 Section in a plane just anterior to the distal wall of the pharynx *A* and including a portion of the greater wing of the sphenoid the basilar process *B* and the abscess in the parapharyngeal area The cavernous sinus area *D* including the internal carotid artery with the associated nerve trunks and ganglia (trigeminal [ophthalmic superior and inferior maxillary (mandibular) abducens oculomotorius and trochlearis]

sphenoid and the basilar process the cavernous sinus the internal carotid artery with the associated nerve trunks and ganglia and a portion of the greater wing of the sphenoid are anatomically recognized (Fig. 12) There are several septic thrombi in the cavernous sinus (Figs. 13 and 14) The extension from the antrum through the maxilla was not limited to the distal direction but involved also the structure immediately above the deciduous central incisor and cuspid the soft tissue between the oral cavity and the tooth crown was normal and unbroken (Fig. 15)

The study of the mandibular sections by Dr Blaney disclosed an osteomyelitic process extending forward from the mandibular foramen to the region of the deciduous cuspid (Fig. 15 *A*) The degree of phlegmonous reaction and the amount of tissue destruction was much more pronounced in the maxilla than in the mandible The mandible was separated from the maxilla at the time of autopsy so that it is impossible to trace the direct extension of the aforementioned infectious process However in a section through the mandibular foramen the abscess may be seen to enter the body of the mandible along with the mandibular nerve and vessels Having seen that the zygomatic process of the maxillary bone had been destroyed and that the contents of the maxillary sinus had entered the pterygomaxillary fossa it is readily understood in what manner the extension could take place along the planes of the buccal fascia the pterygoid muscles, the sheaths of the third division of the fifth nerve and the inferior dental artery thereby entering finally the lower jaw through the mandibular foramen (Fig. 16)

In a section through the first permanent molar region, a large abscess is found immediately beneath the dental pulp in close proximity to the mandibular nerve (Fig. 15, *B*) Inferior to this the major portion of the original mandibular bone is involved in an osteomyelitic process The body of the mandible is completely surrounded by a formation of new bone the trabeculae of which are arranged at right angles to the surface This arrangement of the trabeculae is not present on the normal side and by its form suggests an effort on the part of nature to withstand the effects of internal pressure Studies of the deciduous molar teeth reveal a large area of destruction extension of this process along the lateral wall of the tooth, and complete disorganization of the enamel organ on the occlusal surface The overlying soft tissue despite these pathological alterations is intact thereby discounting any dental focus as a pathogenic factor

Throughout the entire mandibular series we are unable to find a trace of the inferior dental artery from a point posterior to the cuspid region This fact seems to substantiate the statement that the infection entered the lower jaw by extension along the vessel sheath ultimately destroying it, and that the involvement of the lower jaw was not the result of a thrombophlebitis In the anterior region of the mandible the structures are found to be normal in appearance and arrangement

*Summary of the clinical and histological findings*  
The clinical course of the patient becomes coherent after close scrutiny of the serial sections of the entire head There is incontestable evidence that the site of origin of the infection was in the inferior turbinate Following a purulent rhinitis and sinusitis



Fig. 14 Area of cavernous sinus showing veins thrombosed and containing septic thrombi

meatus where it has been destroyed (Fig. 7). This destruction in the inferior turbinate represented the oldest change, the fistula at the floor of the maxillary sinus and the organized thrombus in the cavernous sinus were next in sequence.

#### TREATMENT

Neither experience nor literature seem to solve the problem of therapy in these cases. Extremes of conservatism and radicalism are represented, with a fortunate tendency to the former. A typical experience is that of Ballenger (2), who had 8 spontaneous recoveries out of 11 cases, with no drainage other than that provided by the natural nasal orifices. Two of the cases drained by a spontaneous rupture through the orbit, one through the inner and another through the outer canthus of the eye. The 2 other cases required surgical interference, one an ethmoidal and the other an ethmoidal and orbital drainage. All of these cases recovered. Such an experience is not unusual. Whether packs externally applied should be hot or cold is a matter of controversy, there being enthusiastic proponents for each form of therapy. Intranasal shrinkage and mild suction or irrigation are valuable. Procedures such as infraction of a turbinal, probing or irrigation of sinuses have not met with universal acceptance. The opinion often voiced is that these cases, representing as they do a fulminant type of pathological process, offer a



Fig. 13 High magnification through the internal carotid artery which is filled with septic thrombi

the infant developed a peristalsis of the maxillary process in the maxillary sinus and ethmoidal labyrinth broke down (Fig. 5). From the suppurative process in the maxillary sinus and ethmoidal labyrinth septic thrombi invaded the venous channels producing a cavernous sinus thrombosis (Figs. 12, 13, 14). From the original site, the process extended depending the bone, caused a necrosis which gave rise to a fistulous tract at the floor of the sinus and broke through into the roof of the mouth (Figs. 6 and 7). The facial surface of the maxillary sinus was eroded by the carious process, thereby causing extension by continuity into the zygomatic arch and the soft tissues of the cheek (Figs. 7 and 8). The pterygoid fossa then became included in the extension from the zygoma (Figs. 9 and 10) and, by way of the fascial planes traveling along the pterygoid and buccinator muscles, the mandibular foramen became involved. The invasion of the foramen was by way of the nerve and vessel sheaths, and in the process one nerve was found to remain intact but the vessels were completely destroyed (Fig. 15). The parapharyngeal space contained a broken down abscess (Fig. 11).

The changes in the interior of the nose were most interesting. The osseous portion of the inferior turbinate was replaced by a necrotic mass. This is seen to be almost encysted, hence it would seem to be an older process (Fig. 6) than those which resulted from this infection. The epithelium of the turbinate is almost devoid of cilia although the mucosa is everywhere intact except in the inferior

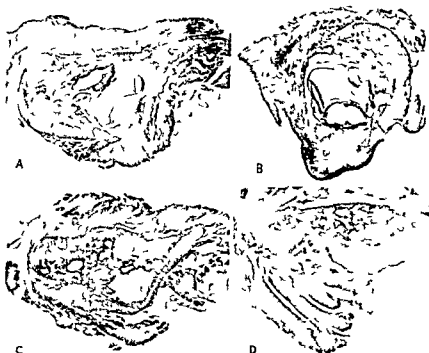


FIG. 1. A study of the mandibular series. A Shows the area immediately above the deciduous central incisor and cuspid involved. However the soft tissue between the oral cavity and tooth crowns is normal and unbroken. B Section through the first permanent molar region. There is an abscess immediately beneath the dental pulp and in close proximity to the mandibular nerve. The major portion of the bone surrounding this area is involved in the osteomyelitic process. The body of the mandible is completely surrounded by new bone with trabeculae arranged at right angles to the surface. C The section through the mandibular foramen shows the abscess entering the body of the lower jaw along with the vessels and the nerve which really constitutes the manner in which infection was carried to the mandible. D The anterior region of the mandible shows a more active osteomyelitic process with sequestration and abscess formation.

better prognosis with a "hands off" policy. Those who have voiced this ultra conservative attitude have probably experienced in their own hands or those of their colleagues unfortunate sequelae of sepsis, osteomyelitis, meningitis and dural sinus thrombosis. They lean therefore toward the opinion that any manipulation in the nose may bring on dire consequences, having no proof that the cases might not have gone on to such complications without these procedures.

In discussing the intranasal cases producing orbital symptoms and abscesses, Faulkner advocates external evacuation of the abscess and extirpation of the ethmoids. Babbitt comments on the similarity in the symptoms of orbital cellulitis and cavernous sinus throm-

bosis; he believes that the percentage of recoveries under radical procedures and the serious prognosis without interference justify initial nasal sinus surgery, even in cases of doubt.

The treatment of orbital cellulitis and abscess varies with the severity of the symptoms according to Hawkins, who treats cases of "pure edema" intranasally. He quotes Logan Turner, who was able to cure 14 of his 38 cases in this manner. Children with ethmoid suppuration and exophthalmos responded to shrinkage suction or irrigation in 24 to 48 hours in Hawkins' cases. He further advises that adults may respond to simple irrigation but according to him may require some type of operative procedure—intranasal external

## NASAL INFECTION

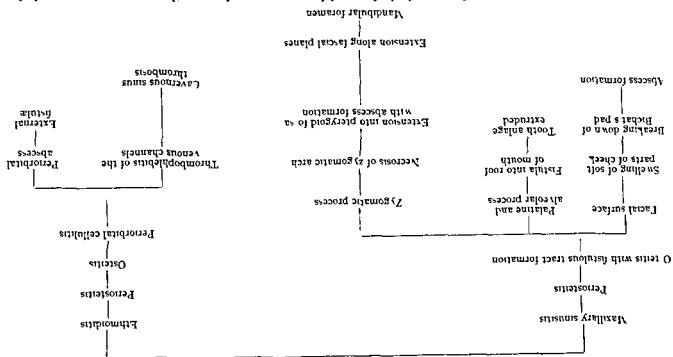


Fig. 16. Graphic representation of the method of spread from a primary focus in the nose to structures of the surrounding portions of the head. It is seen that this chronological representation follows very closely the comparative study of the historical sequence and the study of the histological series. Represented are possibly all the various routes by which a nasal infection may spread to the adjacent parts.

Whatever the type of operation, it should be sufficiently radical to insure adequate drainage. Such a radical attack should be carried out immediately when a cavernous sinus thrombosis manifests itself.

On the basis of clinical reports, it is difficult to arrive at an adequate evaluation of the therapy in these fulminant sinus infections. We can say definitely that conservative meas-

in expectant, conservative, attitude adopted by Porter if there is a simple exudate of the lids (which he terms the first stage) This consists of spinning the nasal mucosa repeatedly. Such cases may be diagnosed as the bacterial invasion is not virulent and its effect will subside in the majority of cases, where

With areas that are not so accessible a surgical approach becomes necessary. As Porter has shown, surgery is obviously indicated when the process is not responding to the expectant treatment and drainage is not established. Intranasal surgery has always been recommended in the presence of an acute infection and statistics seem to indicate that that surgical intervention is attempted in a minimum of 10 to 15 per cent by an appalling majority of otitis media patients. Such statistics are logical only if we know at what stage of the infection drainage was attempted and the character of the procedure employed.

(especially the incident trauma) External procedures rather than intranasal operations have been advised because of a possible spread to the meninges. We feel that here again we should choose the route nearest to the area which we desired to drain and—more important still—should as far as possible avoid operative trauma. We have frequently found it best to advise procedures in accordance with the ability of the surgeon.

### CONCLUSIONS

An interesting histological survey directed toward study of the pathogenesis of osteomyelitis of the maxilla in an infant and of the means of extension and complication reveals a great number of diverse basic factors in cases clinically similar to each other. It is evident from a study of the literature that the portal of entry and method of extension may be variable. Dogmatic statements have been made by proponents of each mode of invasion but a careful study of our case has shown that the various modes of extension may all be involved in such processes. Evidence is presented to show conclusively that nasal infection and sinusitis may play an important role in the pathogenesis of such a process even in early life.

Very few of the cases recorded in the literature have had serial histological studies and because it is difficult to determine the disease complex solely by clinical means dogmatic and erroneous conclusions have been forced upon the rhinologist. The patients are often first seen after some time has elapsed so that the primary process is declared by inference only. The present study offers a logical explanation of many earlier unexplained cases.

We advise an expectant conservative attitude in the early stages of the disease when oedema of the lids is present. If the process does not show a tendency to regress and if symptoms become more marked surgical interference must be contemplated.

The surgical approach can be intranasal or extranasal, the route determined depending upon the proximity to the focus to be drained and the chances of avoiding trauma. The

choice of procedure depends chiefly upon the technical skill of the surgeon.

In the case reported probably no therapy conservative or radical, could have halted the extensions of the bacterial invader or saved the life of the patient. Past experiences would indicate that palliative medication has its distinct merits in the treatment of the majority of cases. Radical interference undertaken at the proper time should give a good prognosis. Of the operative procedures surgery for drainage appears most advantageous.

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# NORMAL HUMAN OVUM IN THE PRIMITIVE STREAK STAGE (APPROXIMATELY EIGHTEEN AND ONE-HALF DAYS)<sup>1</sup> HAROLD O JONES, M.D., F.A.C.S., AND JOHN I BREWER, M.D., CHICAGO, ILLINOIS

These facts and those to follow support the conclusion that this ovum is normal and complete. The normal uterus was removed for the purpose of sterilization. The imbedded ovum was implanted at the usual site on the posterior wall of the uterus. The size and stage of development of the ovum were consistent with the menstrual and coital histories. Invasion of the maternal tissue by fetal elements was in active progress. The fundamental relationships of the embryonic plate, yolk sac, amnion, chorion, villi and endometrium were normal and agreed with those described by Bryce-Teacher, Frass, Ebernd, and others which are accepted generally as normal. The cells of the embryonic plate were in active mitotic division. The Langhans' cells and the cytotrophoblast were multiplying rapidly by generation of the villi. Anchoring villi were few and were loosely attached.

The ovum and the embryonic anlage were anatomically complete and were sectioned and arranged serially. The entire unfixed blastocyst tissue together with a small amount of the surrounding endometrium was divided into four portions and placed in fixing solution. The block of blood supply had been clamped. The block of tissue containing the embryonic anlage was fixed in formalin-Zenker's solution, and the 3 others were placed respectively in Regaud's solution, 10 per cent neutral formalin, and formal-Zenker's solution with subsequent osmic acid fixation. All the tissues were imbedded in paraffin. The block containing the embryonic structures was cut serially at 10 microns, and the sections were stained with haematoxylin and eosin. All other blocks were cut serially at 5 to 6 microns.

The stains used were acid fuchsin-methyl green, acid fuchsin-Mallory III, phosphotungstic acid-haematoxylin, osmic acid counterstained with methyl green, copper chromehaematoxylin, iron alum haematoxylin, scarlet. A comprehensive description of the embryo will be published later from the Gynecological Service and the Henry Baird Fawcett Laboratory of St Luke's Hospital and the Department of Anatomy of the University of Chicago. Added by a grant from the Rockefeller Foundation to the University of Chicago.

COMPARATIVELY few young human ova, normal and anatomically complete, have been described. The ovum to be reported here seems to fulfill these requirements. In addition, an exact sex history has been obtained from the husband and wife as follows

February 16, 1932, menstruation began  
February 22, 1932, menstruation ended  
February 26, 1932, coitus  
February 28, 1932, coitus  
March 4, 1932, coitus (evening)  
March 10, 1932, entered hospital  
March 13, 1932, menstruation expected but failed to occur  
March 24, 1932, hysterectomy (morning)

The body of the uterus as removed measures 5 by 7.5 by 4.5 centimeters and has no pathological changes. The wall is 3 centimeters thick, 1 centimeter being endometrium. The cavity has no blood. On the posterior wall of the endometrium there is a slightly depressed hemorrhagic tissue 1 millimeter in diameter. Centered 1 millimeter directly beneath this is the blastocyst. The external measurements of the unfixed chorionic vesicle are 8 by 7 by 4 millimeters. The internal measurements (chorionic cavity) are 6 by 5 by 2.5 millimeters. The yolk sac is 1 millimeter in diameter before fixation. The amniotic cavity measured in the section is 0.66 by 0.86 by 0.20 millimeters in its greatest dimensions. The caliber measurements of the embryonic disc made on the model at 200 diameters are 1.159 millimeters long by 1.475 millimeters wide. The primitive groove similarly measured is .49 millimeters long. The length of the primitive streak including Hensen's node is 87.5 millimeters. Reduced to actual size the length of the disc is 0.58 millimeters, the width 0.74 millimeters, and the primitive groove 0.205 millimeters, and the primitive streak including Hensen's node 0.438 millimeters.

red Best's carmine, Bielschowsky silver technique, Mayer's muchematein Bismark brown, and hematoxylin and eosin

#### ESTIMATION OF AGE

The coital history presents crucial evidence for determining the age of our ovum. Recent evidence indicates that ovulation usually occurs near the middle of the menstrual cycle (Allen et al). Accordingly the last ovulation in our patient occurred about March 3, 1932. The viability of injected spermatozoa in the human is variously stated to be from 1 to 3 days. Thus the coital relations that occurred on February 26 and 28 are too far separated from the calculated date of ovulation to be significant. The isolated and last coitus on March 4, 19½ days before operation coincides closely with the estimated date of ovulation. On this basis the maximum copulation age is 19½ days. The minimum copulation age is 14 days since the patient was in the hospital 14 days prior to operation. Wall states that the copulation age is 24 hours longer than the actual or fertilization age. Deducting 1 day from the computed ovulation age the fertilization age of our ovum is 18½ days.

The calculated age is substantiated by comparison with other young human ova. The Grosser (K<sub>13</sub>), Ingalls, Heuser, Frassi, and Eternod (A<sub>11</sub>) specimens (about 19 days) have larger measurements, the external diameter of the chorion being 10 millimeters. The Grosser and Ingalls ova have head processes, chordal canals, cloacal membranes, and beginning medullary folds. The Frassi and Eternod ova contain in addition neurentic canals, medullary grooves, and blood vessel formations in the body of the embryos.

The ova described by Miller, Bryce Teacher I, Peters, Jung, Merttens, and Strahl-Beneke have internal chorionic measurements ranging from 0.44 millimeters to 3.8 by 2.2 by 1.2 millimeters. The measurements of the embryonic shields while not absolutely trustworthy, vary up to 0.75 by 0.3 millimeters. The well known Miller and Bryce Teacher I ova have no definitive villi while one described by Peters has beginning villi formations. In the Jung specimen the villi evidence some branching.

In the Strahl-Beneke ovum, a primitive streak is present. The ages of these ova are stated by Streeter to be from 11 to 15 days and by Grosser from 12 to 18 days. (The Miller ovum is not listed in Grosser's classification. Grosser 1927.) Ialkner recently described a human ovum associated with a good clinical history and estimated its age at 15 days. The villi are beginning to branch and the yolk sac is larger than the amnion.

Closely approximating the description of our ovum is that of the Matcer ovum, the age of which is placed by Streeter at 17 days. The measurements of the Matcer ovum, however, are slightly greater. The blood vessels of the villi contained primitive blood cells, while in our specimen the vessels are empty.

Kindred in reporting the Goodwin ovum calculates the age to be about 19 days. Although the given measurements are smaller than those for our ovum, the presence of the described head process indicates it to be more mature.

Our ovum with its primitive groove, allantois, blood vessel formations in the wall of the yolk sac in the body stalk in the chorionic membrane, and in the villi with a yolk sac larger than the amnion and with branching villi falls into Group II of Streeter's classification. The internal measurements of the chorion are also within the limits given by Streeter for this Group. Since our ovum contains the earliest stage in the formation of a neurentic canal that has been described for the human, it is placed in the borderline between Groups II and III (Streeter). It is definitely less advanced than the ova of Group III (Grosser, K<sub>13</sub>, Ingalls, Heuser, Frassi, and Eternod, A<sub>11</sub>).

The more exact estimation of its age (18½ days), the immediate and excellent fixation, the favorable plane of section, and the completeness of the specimen make possible a precise classification of this ovum in the series of human ova.

#### THE VILLI

The villi vary in size and shape and cover the entire surface of the blastocyst (Fig. 1). The longest is 0.1 millimeters. Many are branched once and a few twice. Each has a central mesodermal core and a covering of



syncytium and Langhans' cells. The Langhans' cells are small, cuboidal, or oval, with scant granular cytoplasm, large clear nuclei, and one or two nucleoli (Fig. 2). Each cell has a definite membrane. Many are in mitotic division. Glycogen can be stained in these cells. The vacuolization of the cells as demonstrated by Falkner was not present. The syncytium is a finely granular protoplasmic film with nuclei distributed through it. It is spread irregularly over the surface of the Langhans' cells and stained deeply. The nuclei have a single nucleolus. Glycogen could not be demonstrated in this syncytium. Mitochondria stain as thin threads. In many places there is a brush border. The syncytium does not in this specimen completely surround and wall off the implantation cavity, the picture differing in this respect from that described by other writers.

#### VASCULAR AND VEG

There are blood vessels in various stages of development in the villi chorion, body stalk, and in portions of the wall of the yolk sac. In the villi, chorion, and body stalk the development is similar, while in the yolk sac the formations differ and are considerably more advanced.

All the larger villi contain angioblastic strands or short tubes, while many of the smaller villi do not. In the absence of specific study and plotting, there is no manifest difference in the number or degree of development of vessel formations in the villi chorion and body stalk. All stages from fine mesodermal strands to fully formed short endothelial tubes are present. The strands usually located near the center of the villi consist of groups of mesodermal cells with indistinguishable cell membranes. They are short and, in serial sections, have no connections with other neighboring strands or vessels. Some contain vacuoles in the central portion. Because the cell boundaries could not be discerned, it cannot be stated whether the vacuoles are intracellular or extracellular. By confluence and enlargement of the vacuoles, a lumen is formed, surrounded by a ring of cytoplasm and flattened nuclei. These formations likewise are isolated. A few of the formations are branched.

Fig. 1 Photomicrograph of a slightly oblique section of blastocyst embedded in endometrium. Section 15-2. X12



Since the vessel primordia are distributed evenly through the villi, chorion, and body stalk, since the individual strands and vessels are independent of connections or communications with neighboring strands, and since the formations are equally well differentiated over the entire chorion, they probably arise *in situ*. There are no cells in the lumen of the endothelial tubes in the villi, such as Streeter described for the Mater ovum and called future blood cells. In the body stalk there is similar differentiation of mesoblastic cells into strands—some solid, some with vacuoles, and some with a lumen. There is no evidence that these as yet join with the strands of the chorionic membrane. In a place at the edge of the body stalk is a single blood island formation similar to those observed in the wall of the yolk sac. In the wall of the yolk sac, the blood vessel formations are restricted to the caudoventral



Fig. 3. Photomicrograph of a fetal wandering cell in contact with a decidual cell at the left. Stained with Best's carmine to show glycogen.  $\times 97$ .

Glycogen is present in large cells scattered through the decidua at the sides and base of the blastocyst (Fig. 3). Beneke, P. Meyer, Bryce, Teacher, Peters, Strahl and Falkner describe these large cells but make no statement concerning their glycogen content which in our material distinguishes them from maternal cells. Beneke, Meyer, Strahl and Falkner believe these cells to be of fetal origin while Bryce, Teacher suggest that they are maternal cells. Peters states he is uncertain of their origin.

Two types of fetal wandering cells are evident. In our specimen their origin can be traced definitely to the cytotrophoblast. Cells in the cell columns at the tips of the villi identical with Langhans' cells increase in size, the cytoplasm concentrates about the nuclei and the acid stain is taken with avidity. The cells increase in size, the cytoplasm becomes more dense and the nuclei have one or more clefts and a single large nucleolus. The cytoplasm becomes still more dense and granular, remains concentrated about the nuclei and stains more intensely with acid dyes. In the cytoplasm mitochondria now appear stained as long thin threads and filaments. Figure 6 illustrates such a cell among its neighbors and separated from the decidua by a venous space. The mitochondria are similar in sections fixed in Regaud's solution and in formal Zenker's with subsequent osmic acid fixation for two days. In Figure 7 a wandering cell of one type is shown in the decidua adjacent to a

vessel. By comparison to a decidual cell, the fetal cell is larger. It contains glycogen in this preparation and the decidual cells do not. It has mitochondria, whereas the decidual cells do not. The nuclei of the decidual cells are even, rounded or oval with 1, 2, or 3 small nucleoli in contrast with the cleft nuclei and single large nucleoli of the fetal wandering cells. The other type of fetal wandering cell is illustrated by Figure 5. These cells stain darkly and invade the decidua in streamer-like formations, one cell behind the other. Their shape varies during invasion. Many are elongated and tenuous as in Figure 5. Others located in maternal capillaries are spherical. Many contain glycogen, and in some mitochondria stain as threads and short rods. Some have several nuclei.

#### SYNCYTIUM

The theory that syncytium originates from the cytotrophoblast is upheld by Peters, Streeter, Jung, Miller and others. The theory that it originates from maternal endothelial cells has been so convincingly disproved that it can safely be disregarded. In the ovum reported here the formation of the syncytium is followed from the cytotrophoblast in more detail than has previously been done.

The syncytium develops similarly to the fetal wandering cells as noted above up to the appearance of mitochondria. From here on, a variation occurs. After the formation of the large cytotrophoblastic cells with dense cytoplasm and mitochondria, two or more of the cells fuse to form a multinucleated mass or such a single cell is surrounded and taken up by an already formed syncytial mass. The staining reaction of the syncytium is similar to that of the large cytotrophoblastic cells. Mitochondria remain as thin threads in the syncytium (Fig. 8). Identical changes with the subsequent formation of syncytium take place in the Langhans' cells within the confines of the villi. Since syncytium develops from the Langhans' and the cytotrophoblastic cells in a similar manner, it is evident that these latter two cell types are fundamentally similar and have a common origin. Many of the syncytial masses have brush borders (Fig. 9). Brush borders or prickles

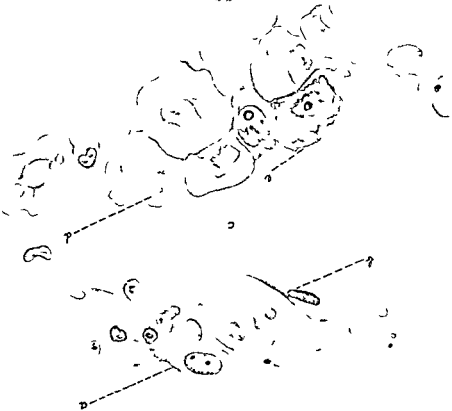


Fig 6 Camera lucida drawing of venous space in penetration zone a, Endometrial stromal cells, b, endothelial lining of venous space c, lumen of venous sinus d, cytotrophoblast replacing endothelial wall, c, cytotrophoblastic cell with mitochondria X725

processes have been noted by Jung, Greenhill or ingestion of maternal stroma cells in the Miller ovum. On the other hand Bryce and

Bencke Marchand, and others. Peters believes these irregular borders are not prickly processes but rather a frayed deposit on the surface. The masses penetrating deepest into the maternal tissue in our ovum do not have these borders, and Bryce-Teacher report similar findings. Numerous masses contain lipid droplets stained with both scarlet red and osmic acid (Fig 9). In the penetration zone many syncytial masses with brush borders contain large and small vacuoles. In sections fixed and stained for lipoids these vacuolated regions do not stain. It is probable that the brush borders are associated with phagocytic activity of the cell masses as suggested by Bartelmez.

In the penetration zone, *Zwischenzone* or zone of necrosis, Grosser reports an abrupt transition from the trophoblast to the maternal tissue in the Kleinhan's ovum and believes the maternal tissue is not destroyed but merely pushed outward. Veit Strahl-Bencke, and P. Meyer also note this outward displacement. Streeter states there is no destruction

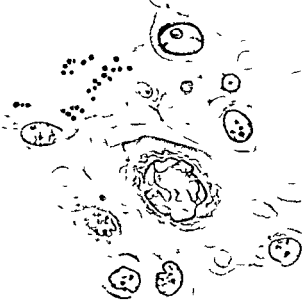


Fig 7 Drawing of a section containing a fetal wanderer cell with mitochondria amidst maternal cells. (Stained with aniline acid fuchsin and methyl green) Camera lucida X1065



Fig. 5. Photomicrograph of a fetal wandering cell in contact with a decidual cell at the left. Stained with Beitz's carmalum to show glycogen.  $\times 9$ .

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hold. In some places formation of fibrinoid amounts are evident, scattered through the advancing cytotrophoblast from which it apparently originates. In other places, the origin is undoubtedly in degenerating maternal cells at the boundary zone. In contrast to the description by Bryce and Teacher, and Jung, in which the fibrinoid is arranged in a layer completely around the ova, it is found only in occasional places in our ovum, while in the Peters' ovum it is entirely wanting. When it occurs, it is located at the junction of the decua and the cytotrophoblast which it separates sharply. The layer is usually thin. In Greenhill's specimen, fibrinoid was being engulfed by the syncytium.

Fibrin occurs mainly in the formation of thrombi. In many places a capillary opens into the intervillous space, one endothelial wall is lost and the other continues along the edge of the normal decua. Adherent for a considerable distance along this remaining capillary wall is a laminated thrombus made of fibrin, and white and red blood cells. Fibrin is located only in the vessels in the penetration zone.

**SUMMARY**

- 1 A normal and anatomically complete human ovum, age 18½ days, is described (Fig 1)
- 2 The tissues were fixed in various solutions within 10 minutes after the clamping of the maternal blood supply.
- 3 An accurate and valuable clinical history is given.
- 4 The embryonic disc is slightly oval and contains
- a The earliest stage in formation of a neuter canal so far described for the human,
  - a primitive streak and groove (Fig-ure 1),
  - a Hensen's node,
  - a local membrane,
  - An allantois
- 5 The villi surround the entire blastocyst (Fig 1) Some are branched (Fig 1) There are a few anchoring villi (Fig 2)
- 6 Blood vessel formations arise *in situ*
- They are identified in the villi, chorionic membranes

We wish to express our appreciation for the valuable suggestions and aid given by Dr George W. Bartelmez

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STUDIES ON ABSORPTION AND EXCRETION IN SEGMENTS  
OF THE COLON OF MAN<sup>1</sup>

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MUCH conflicting experimental evi-

dence exists concerning the absorption of substances other than water by the large intestine. While we were working with a large group of colostomized patients on the combined intestinal service of the Mayo Clinic, it occurred to us that they presented conditions ideally suited to the elimination of the usual fallacies inherent in investigations of colonic absorption, and that, without inconvenience or danger to patients, observations could be made which would be of benefit to all patients. The particular advantages offered by colostomized patients were as follows:

(1) The omnivorous colon of man could be studied, rather than the colons of strictly carnivorous or strictly herbivorous animals. (2) The divided colon would prevent error due to regurgitation of the chyme into the absorbing ileum. (3) Short distal segments could be thoroughly evacuated, thereby eliminating any errors due to failure to recover unabsorbed fractions. (4) Thorough cleansing of the easily accessible, short, distal segment would prevent bacterial fermentation in experiments with carbohydrates.

Test substances were chosen with a view to obtaining additional evidence of absorption other than disappearance from the colonic lumen, as well as for utility of these substances for these purposes, a number of observations were made, using methylene blue, atropine, glucose, sucrose, and arsenic. Experiments were also performed to determine whether some of these substances, orally or intravenously introduced, would be excreted by the colonic segments.

## METHOD

Results with methylene blue are given in Table I, those with atropine, in Table II, and those with glucose in Table III.

## ABSORPTION

Following the process of cleansing, the substance to be tested was instilled in solution through the rubber catheter, and left in the segment for the duration of the observation, as determined by its nature. At the end of this time, the unabsorbed fraction was removed by irrigation, and its quantity determined. That the unabsorbed fraction could effectively be removed in this manner was demonstrated by instilling 30 milligrams of arsenic as neoparsbenamine, in solution, and immediately removing it by irrigation with 1,000 cubic centimeters of water. Analysis of this returned fluid by the Osterberg modification of the Gutzeit method resulted in recovery of 97 per cent of the instilled arsenic.

To determine metabolic factors during the disappearance of glucose from the colonic segments, observations were made on 3 individuals, free of diabetes, on whom colostomy had been performed at the level of the sigmoid, on one individual, who had diabetes graded 3, on whom colostomy had been performed at the level of the sigmoid, and on one individual who had undergone obstructive resection at the level of the sigmoid and who had questionable latent diabetes. Under basal conditions, and estimations of the respiratory quotient and heat production, in calories per square meter per hour, were made by the gasometer method (2), and the values for blood sugar were determined by the Folin-Wu method. Following introduction of 30 or 50 grams of glucose into

The distal colonic segment was thoroughly cleansed by irrigations with warm tap water, rubber catheters were used, as is illustrated in Figure 1. That this cleansing process was

Abstract of thesis submitted by Dr. Curry to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery. Work done in the Division of Medicine and Surgery, The Mayo Clinic.

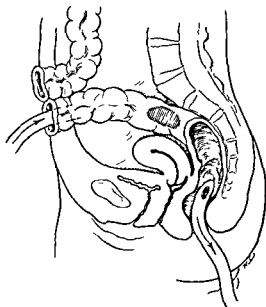


Fig 1 Anatomical condition after double barrel or loop colostomy and method of using catheters

the distal colonic segment, the same determinations were made at hourly intervals for 3 hours with an additional determination of blood sugar at the first half hour. Table IV shows that in each case mentioned in the foregoing there was an increase in heat production, and in 3 instances there was an increase in respiratory quotient above the basal levels at some point during the disappearance of 9.42 to 48.75 grams of glucose from the distal colonic segments.

Among individuals whose carbohydrate metabolism was not impaired, the values for blood sugar maintained a level or fell slightly, but among individuals who had diabetes, definite increases in values for blood sugar accompanied the absorption of the glucose (Table IV).

The metabolic changes in Case 20, graphically represented, are shown in Figure 2.

Sucrose administered parenterally to man is not utilized, but it has been shown by Keith, Wakefield and Power that 97 per cent to 98 per cent of it is excreted in the urine within 24 hours. If sucrose is instilled into distal segments of the colon its subsequent excretion in the urine will be evidence of its absorption by the colon. The invertase hydrolysis method of determination of su-

TABLE I—ABSORPTION OF METHYLENE BLUE

Case	Operation performed	Methylene blue instilled	Time hours	Urine
1	Type X colostomy at sigmoid	1 gm per rectum	24	Green
2	Type X colostomy at sigmoid	1 gm per rectum	4	Green
3	Loop colostomy at sigmoid	1 gm into lower loop	12	Green

TABLE II—ABSORPTION OF 1/75 GRAIN (0.00086 GM) ATROPINE INSTILLED INTO LOWER LOOP

Case	Operation performed	Time hours	Physiological response		
			Salivation	Pupils	Pulse rate beats per minute
4	Loop colostomy at sigmoid		No effect	No effect	
		1	Dry mouth	No effect	
		3	Dry mouth	Pupils dilated	
5	Loop colostomy at sigmoid	1	No effect	No effect	
		2 1/2	Dry mouth	No effect	
		3 1/2	Dry mouth	No effect	
6	Loop colostomy at sigmoid	3	Dry mouth	Pupils dilated	
7	Mikulicz operation on descending colon		No effect	No effect	84
		1	No effect	No effect	88
		1	Dry mouth	No effect	90
		2	Dry mouth	Pupils dilated	88
		2 1/2	Dry mouth	Pupils dilated	90
8	Obstructive resection at sigmoid	1	No effect	No effect	82
		1	No effect	No effect	90
		1 1/2	No effect	No effect	88
		2	Dry mouth	Pupils dilated	86

crose, as described by Jolliffe, Shannon and Smith, was employed.

Two observations on individuals who had undergone colostomy at the level of the sigmoid showed that following instillation of 5 grams of sucrose into the distal colonic segment urinary excretion of sucrose immediately began, 36 milligrams were recovered in 1 hour and 29 milligrams in 2 1/2 hours, in the urine of the 2 subjects. Following removal of the sucrose from the colonic segment, urinary excretion of sucrose abruptly ceased. These



TABLE III—ABSORPTION OF GLUCOSE

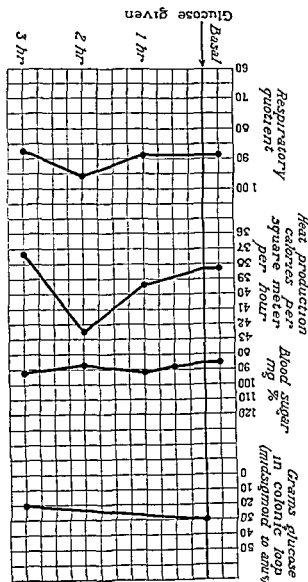
Case	Operation performed	Glucose instilled	Time hours	Glucose recovered	Absorbed per cent
9	Obstructive resection at sigmoid	20 gm into distal loop	5	0	100
10	Type X colostomy at sigmoid	20 gm per rectum	3	11.87	40.7
11	Type X colostomy at sigmoid	20 gm per rectum	3	7.8	61.0
12	Type A colostomy at sigmoid	15 gm per rectum	3	4.4	70.4
13	Sigmoid loop colostomy	20 gm into distal loop	3	1.17	94.2
14	Sigmoid loop colostomy	16 gm into distal loop	3	0.27	98.19
15	Colostomy at middle of descending colon	20 gm per rectum	3	5.8	71.0
16	Loop colostomy at transverse colon	20 gm into distal loop	3	0.19	99.05
17	Cecostomy	20 gm into cecal stoma	3	0	100.0
18	Cecostomy	20 gm into cecal stoma	3	0	100.0

Observations were not recorded in Tables V or VI

Observations made on an individual who had undergone colostomy at the level of the sigmoid disclosed that 5 grams of sucrose, instilled in urinary excretion of sucrose, resulted in urinary excretion of sucrose, and that this excretion continued for 48 hours, 382 milligrams were excreted in the first 24 hours, and 273 milligrams in the second 24 hours. This indicates the slowness of absorption of sucrose. The individual mentioned in the foregoing was 1 of 5 who had undergone colostomy at levels ranging from the sigmoid to that of the middle of the transverse colon. Excretion of sucrose in the urine ranged from 2.6 per cent to 12.5 per cent in 24 hours, and from 1.3 per cent to 19.3 per cent in 48 hours, and the percentages are based on amounts instilled into the distal segments of colon. It was observed that the higher the colostomy, and thus the larger the absorbing surface of the colon, the smaller was the fraction of the total amount of sucrose instilled which was excreted in the urine. This suggested that much of the sucrose not recovered in the urine might have been hydrolyzed to dextrose and levulose, and absorbed as such, since only small

fractions, ranging from 0.03 grams to 0.135 grams remained in the colonic segments at the end of the observation (Table V). Arsenic instilled as neocarsphenamine, in quantities of 0.15 grams, into the distal colonic segments of 7 persons who had undergone colostomy at the level of the sigmoid, resulted in the disappearance of 25 per cent to 100 per cent of the instilled arsenic within 4 hours, the arsenic of the residual fraction was determined by the Osterberg modification of the Gutzeit method. Of arsenic instilled into 2 persons who had undergone cecostomy, 69 per cent and 100 per cent, respectively, disappeared in 4 hours. Excretion of arsenic in the urine did not occur in these experiments. However, when the amount of neocarsphenamine instilled

Fig. 2 Metabolic changes in Case 20



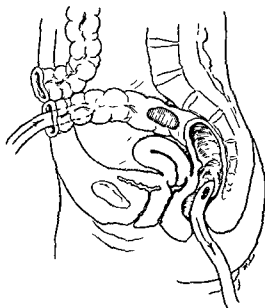


Fig 1 Anatomical condition after double barrel or loop colostomy and method of using catheters

the distal colonic segment, the same determinations were made at hourly intervals for 3 hours, with an additional determination of blood sugar at the first half hour. Table IV shows that in each case mentioned in the foregoing there was an increase in heat production, and in 3 instances there was an increase in respiratory quotient above the basal levels at some point during the disappearance of 9.42 to 48.75 grams of glucose from the distal colonic segments.

Among individuals whose carbohydrate metabolism was not impaired, the values for blood sugar maintained a level or fell slightly but among individuals who had diabetes, definite increases in values for blood sugar accompanied the absorption of the glucose (Table IV).

The metabolic changes in Case 20, graphically represented are shown in Figure 2.

Sucrose administered parenterally to man is not utilized, but it has been shown by Keith, Wakefield and Power that 97 per cent to 98 per cent of it is excreted in the urine within 24 hours. If sucrose is instilled into distal segments of the colon, its subsequent excretion in the urine will be evidence of its absorption by the colon. The invertase hydrolysis method of determination of su-

TABLE I—ABSORPTION OF METHYLENE BLUE

Case	Operation performed	Methylene blue instilled	Time hours	Urine
1	Type A colostomy at sigmoid	1 gm. per rectum	24	Green
2	Type A colostomy at sigmoid	1 gm. per rectum	4	Green
3	Loop colostomy at sigmoid	1 gm. into lower loop	12	Green

TABLE II—ABSORPTION OF 1/75 GRAIN (0.00086 GM.) ATROPINE INSTILLED INTO LOWER LOOP

Case	Operation performed	Time hours	Physiological response		
			Salivation	Pupils	Pulse rate beats per minute
4	Loop colostomy at sigmoid	1	No effect	No effect	
		1	Dry mouth	No effect	
		3	Dry mouth	Pupils dilated	
5	Loop colostomy at sigmoid	1	No effect	No effect	
		2	Dry mouth	No effect	
		3	Dry mouth	No effect	
6	Loop colostomy at sigmoid	3	Dry mouth	Pupils dilated	
7	Mikulicz operation on descending colon	1	No effect	No effect	84
		1	No effect	No effect	85
		1 1/2	Dry mouth	No effect	90
		2	Dry mouth	Pupils dilated	88
		2	Dry mouth	Pupils dilated	90
8	Obstructive resection at sigmoid		No effect	No effect	82
		1	No effect	No effect	90
		1	No effect	No effect	88
		2	Dry mouth	Pupils dilated	86

crose, as described by Jolliffe, Shannon and Smith, was employed.

Two observations on individuals who had undergone colostomy at the level of the sigmoid showed that following instillation of 3 grams of sucrose into the distal colonic segment urinary excretion of sucrose immediately began, 36 milligrams were recovered in 1 hour and 29 milligrams in 2 1/2 hours, in the urine of the 2 subjects. Following removal of the sucrose from the colonic segment urinary excretion of sucrose abruptly ceased. These

TABLE V—SUCROSE ABSORPTION

Case	Operation performed	Sigmoid loop colostomy	5	4	Hour after instillation	Sucrose re covered in urine gm	Sucrose excreted per cent	Sucrose re in segment gm
24	Sigmoid loop colostomy	5	4	0.080				
			8	0.113				
			24	0.186				
			48	0.273				
25	Sigmoid single barrel colostomy	5	21	0.695				
26	Sigmoid loop colostomy	5	24	0.605				
			48	0.359				
27	Descending loop colostomy	10	24	0.492				
28	Obstructive resection transverse		5	0.133				
			24	0.024				
			48	0.031				

of the colon in the following 5 hours, although urinary excretion of the dye occurred at that time

Glucose, intravenously administered in amounts of 25 grams, was not excreted by the distal part of the colon

Sucrose, intravenously administered in amounts of 5 grams, was not excreted by the colon in the subsequent 18 or 19 hours, al-

Results with arsenic are given in Table VIII during that time

COMMENT

The undoubted functions of the colon consist in storage and propulsion of the stool, absorption of water (17, 24). There is additional experimental evidence to indicate that from certain animals definite amounts of protein, carbohydrates, salts, metals, anesthetics, and drugs may be absorbed (4, 5, 7, 22, 27, 32, 33). Bacteria may be absorbed rapidly from the colon, and experiments on animals indicate that rectally introduced glucose results in a greater deposit of carbohydrate in the liver than occurs after its intravenous administration (8, 24, 28). Functionally the proximal and distal halves of the colon are regarded as dual organs. The proximal half is regarded as the absorptive portion, and the distal half as the organ of

from calcium to and definite amounts of protein, carbohydryate, salts, metals, anesthetics, and drugs may be absorbed (4, 5, 7, 27, 32, 33). Bacteria may be absorbed and rapidly from the colon, and experiments on animals indicate that rectally introduced glucose results in a greater deposit of carbohydryate in the liver than occurs after its intravenous administration (8, 24, 28). Functionally the proximal and distal halves of the colon are regarded as dual organs. The proximal half is regarded as the absorptive portion, and the distal half as the organ of

storage and propulsion. This division of function is based upon the following observations: (1) The distal part of the colon is developed from the midgut along with the absorptive small intestine, while the distal part is developed from the hindgut. (2) The proximal part of the colon is of larger caliber, and its walls are thinner than the smaller, thick walled, distal portion. (3) The prevailing types of movement in the proximal part of the colon, particularly at the caecum, are churning and antiperistalsis, whereas in the distal part the prevailing type of movement is propulsive. The content of the proximal part of the colon

TABLE VII—ABSORPTION OF ARSENIC FOLLOW-  
ING INSTILLATION OF 0.6 GRAM OF NEO-  
ARSPHENAMINE PER RECTUM

Case	Date	Operation performed	Arsenic in urine after	Arsenic in prostatic gland	Arsenic in distal segment	Arsenic in mgm.
38	9 1 32	Obstructive resection of sigmoid	0.44			
	9 5 32					
	9 1 32					
39	8-30-32	Sigmoid loop colostomy	0			
	9 1 32					
	9-5-32					
	9-5-32					

TABLE VI—ABSORPTION OF ARSENIC IN FOUR HOURS FOLLOWING INSTALLATION OF 0.15 GRAM OF NEOARSPHENAMINE PER RECTUM

Case	Operation performed	Aseptic segment from colonic incision	Aseptic recovered apparently from colonic segment	per cent
29	Loop colostomy at sigmoid	22	25	25
30	Loop colostomy at sigmoid	12	59	71
31	Loop colostomy at sigmoid	8	71	71
32	Loop colostomy at sigmoid	7	70	76
33	Loop colostomy at sigmoid	1	93	100
34	Loop colostomy at sigmoid	0	100	100
35	Loop colostomy at sigmoid	0	100	100
36	Cecostomy	9	69	93
37	Cecostomy	0	100	100

TABLE VIII—EXCRETION OF ARSENIC AFTER ADMINISTRATION BY MOUTH OF TWO TABLETS OF TREPARSOL

Case	Date	Operation performed	Arsenic in urine mgm.	Arsenic excreted by distal segment of colon mgm.
40	10-12-32	Type A colostomy at sigmoid	0	
	10-13-32			
	10-13-32		61	Trace
	10-14-32			
	10-14-32		0.3	
	10-15-32			
	10-15-32		0	0
	10-15-32			
	10-16-32		0	
40	10-17-32	Subtotal colectomy with ileostomy	0	
	10-17-32			
	10-18-32			0.3
	10-18-32			
	10-19-32		0.8	5.4
	10-19-32			
	10-19-32		0.15	0.5
	10-20-32			
	10-20-32		0.5	0
	10-21-32			

is liquid, whereas that of the distal part is solid or semisolid

Opinion is still divided as to whether material, other than water, which disappears from the lumen of the colon, is actually absorbed. It has been pointed out that the major fallacies in the assumption that colonic absorption is the cause of this disappearance, are (1) the probability of antiperistalsis carrying the test substance up into the absorbing ileum, (2) the inability completely to cleanse the undivided colon, and the consequent questionably complete removal of the unabsorbed fraction of test substance, and (3) the possibility of destruction of the test substance by bacterial action.

In our work these objections were overcome by (1) the operative division of the colon, which precluded the possibility of loss by antiperistalsis, (2) the shortness of the colonic segment, from which a test substance could be completely removed immediately after its introduction, (3) the possibility of complete

cleansing of the easily accessible colonic segment, so that the remaining intestinal content is incapable of fermenting glucose by incubation *in vitro*, (4) the use of further criteria of absorption, other than disappearance of the test substance from the colonic lumen.

The further criteria just mentioned require comment. The evidences of absorption of methylene blue, of atropine, and of arsenic, which were employed, have been recorded in applicable tables.

Much dissenting opinion exists over the question of colonic absorption of glucose (3, 4, 6, 9, 10, 11, 12, 16, 17, 18, 20, 21, 23, 25, 26, 27, 28, 29, 30, 31). Failure of values for blood sugar in the peripheral blood to increase during the disappearance of glucose from the lumen of the colon has been the basis of some conclusions as to the failure of the colon to absorb glucose. Actually, if the factors by means of which sugar is removed from the blood stream are not impaired, the values for peripheral blood sugar would be expected to be unaltered, or to be perhaps slightly reduced, due to pancreatic stimulation, during the colonic absorption of glucose. This is what occurred during our observations of subjects who were free of diabetes. On the other hand, in the observations on a diabetic subject, the values for peripheral blood sugar definitely increased during the absorption of glucose from the colonic segment. In addition, increases above the basal level, in the respiratory quotient or in heat production, in calories per square meter per hour, or in both, occurred at some time during the colonic absorption of glucose, in all observations.

If a sugar which is not metabolized in the body is absorbed unchanged by a colonic segment, its subsequent excretion into the urine, and its recovery therefrom, is definite proof of absorption. For that purpose sucrose was instilled into distal colonic loops and recovered unchanged, in the urine, in significant amounts in all observations. Absorption of this substance was shown to be extremely slow, since urinary excretion, although beginning within an hour from the time of introduction of the sucrose into the colonic loop, continued for 48 hours, but could be terminated by removing the sucrose from the colon. Only a portion of

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over the same period of time

some instances exceeded the urinary excretion of distal colonic segments in amounts which in administered orally as trepanol, was excreted by venously administered Arsenic, when administered orally it had been intravenously administered, when 25 grams of sucrose, when 5 grams of it had been intravenously administered, glucose, when 25 grams of it had been intravenously administered, which had been orally administered in amounts sufficient to not excrete methylene blue, which had been Distal segments of the colon of man did process peripheral blood sugar accompanied this or both. In the presence of impaired utilization of carbohydrate, increases in values for piratory quotient or increased heat production, glucose, which disappeared from the colonic segment, accompanied by an increased respiration, which was excreted in the urine, and the proximal part of the intestine, and excreted in the urine and in the stools from neoparsphenamine, which subsequently was excreted in the urine, arsenic as subsequently was excreted in the urine, which sub-atropine, which caused pupillary dilatation, which subsequently was excreted in the urine, man were shown to absorb methylene blue, least absorptive or distal half of the colon of Distal segments of the generally regarded

CONCLUSIONS

arsenic have been presented

with methylene blue, glucose, sucrose and reduced orally or intravenously. The results excreted by the same segment when intravenously absorbed by the distal part of the colon, were whether the same substances shown to be work on excretion was designed to determine been shown to be excreted in the faeces. Our Numerous metals and metallic salts have tross and levulose and absorbed as such the instilled sucrose was absorbed as such by the colonic segment. It is possible that the remainder may have been hydrolyzed to dextrose and levulose and absorbed as such

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# SOME PRINCIPLES OF LOCAL ANÆSTHESIA

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I have been studying the question of local anæsthesia for more than 25 years. At the surgical clinic of Professor Dollinger we performed 6,000 operations under local anæsthesia—95 per cent of all cases—as reported by Professor Dollinger in 1913 at the International Congress of Surgeons in London. This number has not been reached by any other surgeon as yet. Together with my 1,200 cases operated upon at the Zita Hospital, 7,200 operations have been performed under procaine anæsthesia, tutocaine has been used in 6,675 cases, nupercaine in 4,940, pantocaine in 4,982, this makes a total of 23,797 major operations and if I add our 8,000 operations performed on out-patients, I can report 31,797 operations performed under local anæsthesia, without a single fatality during operation. This is such a great number and the result is so excellent that it seems worth while to draw a few useful conclusions. Methods have been amply commented upon in the works of Schleich, Braun, Reclus, and Pauchet, therefore I only wish to call attention to some practical points.

## CHOICE OF ANÆSTHETIC

The first important problem is the choice of a good anæsthetic. Since I had no fatality with procaine, the question may be raised, why I abandoned it and why I later abandoned tutocaine and nupercaine as well. I can easily answer that "better" is the enemy of "good." In any case, it seems worth while to examine this problem more closely. What is required of a good anæsthetic? This question I answered in my lecture at the Congress in Sopron in 1929 as follows:

1. It must be a substance capable of paralyzing the nerve tissue at a low concentration, without being a protoplasmic poison to the other tissues.

2. The anæsthetic possesses a specific affinity to the nerve tissue and it enters the circulation it may seriously intoxicate the central nervous system, therefore it must be conveyed from the sensitive part.

It must be stressed that even the smallest sensitive field during operation should receive due care. Sensitivity of the smallest spot may spoil the entire effect of anæsthesia, for the patient is not conscious of the painless phrases of the operation and remembers only the pain conveyed from the sensitive part.

It is likely, however, that contractions, stretching, anæmia of the bowel, sufficient duration and summation of various stimuli, changes in the vicinity, are capable of producing pain.

Sensory nerve fibres can be demonstrated in the stomach, bowel, vessels, lungs and so on—although not in cartilage—but very probably the receptors of the bowel are different from those of the skin. Pressure, crushing, stinging, burning of the skin are painful, whereas the same stimuli cause no pain if applied to the bowel or to the lung. It is likely, however, that contractions, stretching, anæmia of the bowel, sufficient duration and summation of various stimuli, changes in the vicinity, are capable of producing pain.

The nerves supplying the individual organs are for the most part well known, unless they are thoroughly understood, good anæsthesia is impossible. No doubt, there may be a great difference between the sensitiveness of one individual and another or of one organ and another, but if a really good anæsthesia is to be obtained, this difference should not be relied upon, but each individual and each organ should be considered sensitive not only skin, muscle, fascia, bone, joints, pleura, peritoneum, but also stomach, bowel, bladder, parenchymatous organs, vessels and so on.

Physical correlative of the psychic experience of pain sensation consists in an excitation process of the afferent nervous system (Foerster).

PAIN is a psychic experience well known to all of us (Foerster). Undoubtedly, pain is often a warning that our body or some organ of it is diseased and needs rest. Pain is, however, not always a beneficial factor, it may also be a useless torturer. As to operative pain and pain of incurable disease, the ancient Hippocratic adage "*dolendum est opus sedare dolorem*" has remained valid to this day.

retained at the site of injection as long as possible

3 The change brought about in the sensory nerve by the anæsthetic must cease after a certain time without leaving a trace

4 The anæsthetic must be transformed locally by the tissues in order to be released into the circulation in a detoxified state

5 From a surgical point of view it is important that it be water soluble, boilable, and not liable to decomposition during sterilization. It must not irritate the tissues or cause pain on injection. It must mix with epinephrin in order to be retained locally

Even though an anæsthetic fulfills all these requirements, we must still take into account the fact that the more efficacious an anæsthetic is, the greater its toxicity. In the living organism however, toxicity of many compounds becomes modified under the influence of certain factors. It must be specially emphasized that the diffusion speed of an aqueous solution depends on the quality of the solved substance, on the permeability of the membranes separating the solutions, and on the concentration of the solution.

The main cause of my changing anæsthetics, therefore, was my endeavor to use substances of the lowest possible effective concentration, in order to depress the diffusion speed. In a major operation 150 to 180 cubic centimeters of anæsthetic solution is required. If a 1 per cent procaine solution is employed, this means not only the introduction of 1.5 to 1.8 grams of foreign substance into the organism, but also the use of a 1 per cent solution, the absorption of which, on account of its relatively high concentration, is quicker than that of a 0.25 per cent tutocaine or a 0.1 per cent pantocaine solution. This will certainly increase the toxicity. That this is true is evidenced by the fact that palpitation, pallor, diffuse sweating, rapid pulse, even nausea and vomiting during or shortly after anæsthesia were almost constant concomitant symptoms of procaine anæsthesia, whereas since I have used the solutions of low concentration, the symptoms mentioned have become an extremely rare occurrence.

Second, the anatomical site of the operation needs careful consideration. On the head,

neck or near the spinal column one cannot with impunity, use as great quantities of anæsthetic as may be used far from the central nervous system, e.g., on the extremities, whence the anæsthetic must pass many more cells before reaching the central nervous system and in this way be more likely to become thoroughly modified or detoxified.

Not only have intoxications ceased to appear in our patients but better anæsthetic effects are obtained even in the hands of the young members of the staff of my clinic. This improvement, I am convinced, is due not only to ample opportunity afforded staff members to see and to learn the technique of anæsthesia and the suggestive influence on new patients of those already operated on, but also to the fact that a sufficient quantity of this diluted anæsthetic to anæsthetize any operative field may be safely used. Nevertheless I would warn against injecting too great an amount at once, the dose should remain far below the toxic dose. If the patient should feel pain during operation the few milligrams of anæsthetic which will have been already detoxified allow for the injection of a considerable amount of additional anæsthetic solution. This continuous supplementing dosage, according to the needs, makes it possible to complete under local anæsthesia any operation started under local anæsthesia. The fact that in complicated operations of long duration we do not inject large quantities of anæsthetic at once, may account for our record of not a single fatality in a vast number of cases.

#### METHODS

With adoption of certain modifications, I returned to and use extensively the Schleich, Hackenbruch, and Oberst methods—the latter, of course, without tourniquet—all methods of nerve block anæsthesia—trigeminal, cervical, Kulenkampff plexus, the Keppler, Haertel methods and so on—carried out as well endoneurally as perineurally. In the abdominal cavity I use the Braun anæsthesia of the solar plexus, of the hypogastric plexus, also parasacral anæsthesia and infiltration of mesenteric attachments. Paravertebral anæsthesia I now use exclusively in kidney operations.



Complicated methods in general are likely to fail Their drawback is that in case of failure another method has to be resorted to, and this must be one performable in the operative field By complicated method I do not mean a block anaesthesia in which the nerves are outside the operative field but may be reached without changing the patient's posture to any great extent In general, anaesthesia should be brought nearer to the field of operation

I abandoned not only paravertebral anaesthesia, but also trunk anaesthesia of the major and minor splanchnic nerves (suggested formerly by myself), and the solar plexus anaesthesia of Kappis I do not employ the high sacral anaesthesia as recommended by Schuster, nor the method of pouring anaesthetic solution into the abdominal cavity as suggested by Seidel I shall not return to spinal anaesthesia and I am not inclined to use even the controllable form as described by Kirschner (control by air suflation) as long as I hear that there is one fatality in each 300 cases and that excruciating headaches lasting for days, and bladder paralyses are often observed

OBJECTIONS AND CONTRA-INDICATIONS TO LOCAL ANAESTHESIA

What are the drawbacks of local anaesthesia? It is said that it requires a special training. This is true, but it is not a disadvantage. Moreover, in most operations the methods have been so greatly simplified that they may be easily learned. Occasionally fall of blood pressure or certain toxic symptoms will occur. These, however, become progressively more uncommon, more-over, they cannot be compared with troubles observed in general anaesthesia. It has been asserted, too, that some greater vessel may be injured. With some care this can easily be avoided, and even if an injury occurs, it will cause no serious trouble, provided the injury is perceived and no anaesthetic is injected into the vessel. In infiltrating the deep layers I never use too sharp needles and in this way the orientation as to the layers is made easier. Tissue necrosis spreading of the infection, it has rather tended to fail. Their drawback is that in case of failure another method has to be resorted to, and this must be one performable in the operative field. By complicated method I do not mean a block anaesthesia in which the nerves are outside the operative field but may be reached without changing the patient's posture to any great extent. In general, anaesthesia should be brought nearer to the field of operation. I abandoned not only paravertebral anaesthesia, but also trunk anaesthesia of the major and minor splanchnic nerves (suggested formerly by myself), and the solar plexus anaesthesia of Kappis. I do not employ the high sacral anaesthesia as recommended by Schuster, nor the method of pouring anaesthetic solution into the abdominal cavity as suggested by Seidel. I shall not return to spinal anaesthesia and I am not inclined to use even the controllable form as described by Kirschner (control by air suflation) as long as I hear that there is one fatality in each 300 cases and that excruciating headaches lasting for days, and bladder paralyses are often observed.

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No doubt active hyperaemia increases excitability of sensory nerves, whereas passive hyperaemia depresses the same. Nevertheless, I do not recommend the classic Oberst anaesthesia, and even less do I recommend applying the constricting bandage to an anaesthetic field, since constriction itself is painful. Many surgeons are disinclined to employ local anaesthesia in inflammatory conditions because they fear that forcing the solution into the tense tissue may cause pain, they are afraid also that infective matter may be conveyed into healthy tissues, and give rise to a spreading infection. I never have been restrained by inflamed tissues from operating under local anaesthesia and I never saw any unfortunate consequence. Of course, if the field is of small size, I prefer circular infiltration in the healthy tissues, or if it seems necessary, I do not refrain from infiltrating the inflamed tissue. In such cases I use a very fine needle and I inject the solution at a slow rate. I do not enter healthy regions from inflamed ones. In my experience infiltration of inflamed tissues never caused spreading of the infection, it has rather tended

toward quicker amelioration or even subsidence of the inflammation, possibly by abolishing pain. Of course I readily admit that there are cases in which a superficial ethyl chloride inhalation is to be preferred to a more complicated local anæsthesia (e g, mas titis and so on).

Hohmeier and a few other surgeons describe a method of infiltration which consists in pushing the needle forward until bone contact is felt and infiltrating the layers while pulling back the needle. This method is not too gentle. The solution should always precede the needle, because in this way infiltration is entirely painless and injury to vessels is not likely to occur.

Anæsthesia must be induced without causing pain. Methods using intravenous or other kinds of narcosis for performing local anæsthesia are needless. Local anæsthesia needs gentleness, patience and anatomical knowledge, if it fails the patient should be given ethyl chloride or ether, but he must not be allowed to suffer. I have simplified the technique of inducing anæsthesia to such an extent that the patient feels only one or at most two superficial needle pricks. In this manner I am able to operate on a steadily increasing number of children under local anæsthesia.

I often read that fat or hysterical women are not suited for local anæsthesia. I cannot agree with this. In fat women I consider narcosis contra indicated whereas the majority of hysterical women are very well suited for local anæsthesia, especially if they are kept in the hospital for a few days before being operated upon.

I have not observed any untoward effect from block anæsthesia either in diabetic or in arteriosclerotic patients. Epinephrin, however injected near to necrotic tissues may cause spread of necrosis.

#### ADVANTAGES AND ABSOLUTE INDICATIONS

And now, what are the advantages of local anæsthesia? A point of economy is that no medical assistant is needed during operation or until the awakening of the patient. The operation is not complicated by a simultaneous procedure, the narcosis, which is fraught with a graver danger than the operation itself,

since, although it is almost out of the control of the operating surgeon, he is nevertheless responsible for its risks.

Local anæsthesia can be employed in all cases in which general anæsthesia would be dangerous. It has a great importance in bone fractures. If 20 cubic centimeters of a 0.1 per cent pantocaine solution is injected between the bone ends, pain and muscular contraction promptly cease and the fracture may be easily and painlessly reduced. No block or circular infiltration anæsthesia is needed. In general medical practice it saves a great deal of suffering. The general practitioner cannot be required to perform under narcosis lumbar or costal puncture or puncture of the pleural or peritoneal cavity, of joints, of a parane phric abscess (nor is the practice indicated), but he should be required to anæsthetize the skin at the puncture site and the entire way of the needle. In this way breakage of needles will be avoided and the patient will not be in fear of a future repetition of the procedure. The argument that the patient has to suffer a prick even if anæsthetized and that a puncture is performed so quickly as to make anæsthesia superfluous does not hold. The single layers, especially the pleura and the peritoneum, are very sensitive, and even after the needle has been introduced, the slightest movement of the needle during tapping may cause considerable pain.

Local anæsthesia is indicated in all operations if there is no particular contra indication—psychic causes, greater simplicity of general anæsthesia—because it is simpler and safer.

There are certain operations which I never perform under general anæsthesia. In heart disease, emphysema, bronchitis, arteriosclerosis, kidney disease in impaired liver function or in bad operative risks narcosis is contra indicated. Cosmetic operations, and interventions that are not absolutely necessary (removal of scars, benign tumors), certain plastic operations, hemorrhaphies—especially umbilical hernias of fat women—I perform exclusively under local anæsthesia, because I consider it inexcusable to expose the patient to the danger of narcosis if the same operation can be performed safely under local anæsthesia. The same applies to trepanation,

I readily admit that postoperative pneumonia is observed also in patients operated upon under local anæsthesia, it shows, however, a more favorable course and is more easily treated. There is no doubt that local anæsthesia is less likely to be followed by postoperative heart, liver, and kidney damage.

It is not fair to compare mortality of operations performed under general and local anæsthesia, respectively, because many poor risks are operated upon under local anæsthesia who were refused operation, or they were operated upon under narcosis and died. In seriously impaired liver function the results of local anæsthesia are conspicuously better than those of general anæsthesia.

What is still to be required of an ideal anæsthetic?

In my opinion it would be of great benefit if the anæsthetic or at least the hypæsthetic effect could be prolonged. The effect is sufficient for the performance of the most extensive operations, it would be desirable, however, if the operative field could be made painless for at least 24 hours.

After narcosis, the patient, being still under local anæsthesia, after pain sensation of the wound has returned, the patient does not breathe deeply and does not ventilate his lungs. If, however, the pain could be abolished for 6 to 18 hours, the patient would dare to move, to breathe deeply. In this way many bed sores, many cases of pneumonia could be prevented and the patient could be spared much pain, for pain decreases with each additional hour elapsing after operation. After 24 hours the wound does not ache at all. In my opinion, therefore, after anæsthesia, a painless period lasting 24 hours should be aimed at. In this respect nupercaine opened a new perspective and if we succeed in securing a 24 hour painlessness, the ideal goal of entirely painless operative healing will be reached.

OUR CASES SINCE 1920

Type of anæsthesia	Site of operation	Number of cases		
		Local anæsthesia + narcosis	Local anæsthesia	Total
Block anæsthesia	Head	327	23	350
	Neck	509	none	509
	Thorax	204	8	212
	Abdomen	150	22	172
	Upper extremity	181	4	185
	Lower extremity	337	3	340
	Hernia	3 950	6	3 956
	Rectum	818	none	818
	Stomach	860	20	880
	Bile passages	1 053	91	1 144
Braun solar plexus	Spleen	4	none	4
	Small intestine	91	10	101
	Colon	121	none	121
	Appendix	4 018	248	4 266
	Female genitalia	20	7	27
	Ribs (thoracoplasty)	51	2	53
Paravertebral (Ruhmer Nozkaev type) (Erges type)	Kidney	51	12	63
	Female genitalia	9	1	10
Parasacral	Prostate	27	5	32
	Bladder	23	6	29
	Rectum	46	1	47
	Vagina	17	none	17
	Female genitalia	9	1	10
Total	Linear infiltration	1 773	459	2 232
	Narcosis	14 720	1 025	15 745
		(80 per cent)	(25 per cent)	

operations on the face, mouth, neck, thorax, and the genito-urinary apparatus, which I perform almost exclusively under local anæsthesia. I employ narcosis only in certain abdominal operations and in operations on the extremities if local anæsthesia has proved unsatisfactory or if narcosis is simpler and not contra-indicated, in long standing jaundice, however, narcosis may be followed by serious injury to the liver.

OUR CASES SINCE 1920

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OUR CASES SINCE 1926

Total number of operations 18 213		Total Narcosis		Total Linear infiltration		Paravertebral (Ruhmer-Noskay type)		Mesenterial		Braun solar plexus		Block anesthesia		Total										
Site of operation	Local anesthesia	Local anesthesia + narcosis		Local anesthesia		Local anesthesia		Local anesthesia		Local anesthesia		Local anesthesia		Local anesthesia										
		Head	Neck	Thorax	Abdomen	Upper extremity	Lower extremity	Hernia	Rectum	Stomach	Bile passages	Spleen	Small intestine	Colon	Appendix	Female genitalia	Rubs (thoraco-plasty)	Kidney	Female genitalia	Vagina	Rectum	Bladder	Prostate	
		13	509	204	150	181	337	3 950	858	800	1 053	4	91	10	121	4 018	20	81	81	9	17	46	23	27
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## VARIATIONS OF THE FEMALE PELVIS IN RELATION TO LABOR

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VARIATIONS of the female pelvis which are not abnormalities in the usual sense occur with relative frequency, a fact to which I called attention in 1932 (4). A common variation which we have studied is characterized by a shortening of the transverse diameter of the superior strait often associated with an increased anteroposterior diameter. In such pelvises this plane appears essentially round, while in some, the anteroposterior diameter is actually increased over that of the transverse, making the pelvis of the true dolichopellic type described in 1886 by Turner.

In 1933 Caldwell and Moloy reported on the anatomical variations of female pelvises and classified them into 4 general groups—the gynecoid, android, anthropoid, and platypellic types. These authors further subdivided their classification to include pelvises which may be admixtures of the types noted and employed such terms as android anthropoid, android gynecoid, android flat, anthropoid gynecoid, gynecoid flat, etc. While these designations are interesting and descriptive it is obvious that for general clinical purposes a more simple classification is essential. I have recently suggested that such a classification can be based chiefly upon the general conformation of the superior strait as is shown in the following grouping:

1. *The female type* The normal female pelvis of other classifications. The superior strait is ovoid in shape, the transverse diameter being more than 1 centimeter longer than the anteroposterior diameter. The pelvis may be classified as large, average, or small, dependent upon the length of the anteroposterior diameter. If this diameter is 12 centimeters or over, the pelvis is designated as large female type. If the diameter is under 10.5 centimeters it is designated as small female type. In rare instances the length of the transverse diameter may be so increased over that of the anteroposterior

diameter as to render a distinctly flattened appearance to the superior strait. In any instance therefore where the transverse diameter is longer than the anteroposterior by 3 centimeters or more, such a pelvis is spoken of as flat female type. For example, the anteroposterior diameter being 9.5 centimeters with the transverse diameter 12.5 centimeters, the pelvis would be designated small flat female type.

2. *The round type* The superior strait in this type has a distinctly round appearance, the transverse diameter predominating in length over the anteroposterior by 1 centimeter or less. The pelvis may be classified as large, average or small, dependent upon the length of the anteroposterior diameter. If this diameter is 13 centimeters or over, the pelvis is designated as large round type. If this diameter is less than 11 centimeters it is designated as small round type.

3. *The anthropoid type* The superior strait appears elongated anteroposteriorly. The anteroposterior diameter is longer than the transverse. The pelvis may be classified as large, average or small, dependent upon the length of the anteroposterior diameter. If this diameter is 14 centimeters or over the pelvis is designated as large anthropoid type. If this diameter is less than 11.5 centimeters it is designated as small anthropoid type.

To differentiate readily large and small pelvises in these types we may summarize as follows:

*Large pelvis*

- Female Type—Anteroposterior diameter of 12 centimeters or over
- Round Type—Anteroposterior diameter of 13 centimeters or over
- Anthropoid Type—Anteroposterior diameter of 14 centimeters or over

*Small pelvis*

- Female Type—Anteroposterior diameter less than 10.5 centimeters
- Round Type—Anteroposterior diameter less than 11.0 centimeters
- Anthropoid Type—Anteroposterior diameter less than 11.5 centimeters



the external conjugate measured 17 5 centimeters with true anteroposterior diameters of 11 0, 11 0, 12 5, 11 5, 11 0, 10 5, 9 5, 9 5. In 5 instances the external conjugate measured 17 0 centimeters with a true anteroposterior diameter of 11 0, 11 0, 12 0, 12 5, 11 5. These figures show the impossibility of establishing any true relationship between the length of the external conjugate diameter and the true anteroposterior diameter of the superior strait.

With regard to external pelvimetry of the pelvic outlet the situation is different. Here the bony points to be measured are easily palpable externally and our mensuration of the diameters of the outlet should be reasonably accurate. I believe therefore that the most practical methods of determining the dimensions of the female pelvis in the living are those of roentgen pelvimetry of the superior strait and external pelvimetry of the pelvic outlet.

Perhaps at this point a word should be said with regard to the determination of the diagonal conjugate diameter by means of vaginal touch. We have found that in primiparous patients this is usually an unsatisfactory procedure due to the rigidity of the soft parts and to the discomfort experienced by the patient. Furthermore, it is obvious that in most of the round type and anthropoid type pelvises, the procedure is of little use as the fingers of the examiner are not as a rule sufficiently long to reach the sacral promontory.

In studying the character of the labor in 100 primiparous women whose pelvis come under the classification just noted the following facts were observed:

#### PELVES OF THE FEMALE TYPE

Of the 49 cases presenting pelvis classified as female type (42 white 7 colored) 39 were delivered spontaneously and 10 by operative procedures. In 7 instances the occiput entered the posterior half of the pelvis (13 per cent of vertex presentations). This occurred 3 times in the average female type, 3 times in the small flat female type and once in the small female type.

#### PELVES OF THE ROUND TYPE

Of the 37 cases presenting pelvis classified as round type (32 white 5 colored) 26 were

delivered spontaneously and 11 by operative procedures. In 7 of this group (7 of 34 vertex presentations, or 20 per cent) the occiput entered the posterior half of the pelvis.

#### PELVES OF THE ANTHROPOID TYPE

Of the 15 cases presenting pelvis classified as anthropoid type (12 white, 3 colored) 12 were delivered spontaneously and 3 by operative procedures. In 8 cases (8 of 14 vertex presentations, or 57 per cent) the occiput entered the posterior half of the pelvis.

#### DURATION OF LABOR

Many factors influence the duration of labor in primiparous patients, such as the strength and frequency of the uterine contractions, the size of the fetus, the malleability of the fetal head, etc. However, the size and shape of the pelvis is one of the important factors. While no definite conclusions can be drawn from the following data concerning the length of labor in the series in question, the figures as given may be of interest.

<i>Female type series</i>	hours
Average duration of labor for the series	16 $\frac{1}{2}$
Average duration of labor in large type	18 $\frac{1}{2}$
Average duration of labor in small type	20 $\frac{1}{2}$
<i>Round type series</i>	
Average duration of labor for the series	17 $\frac{1}{2}$
Average duration of labor in large type	15 $\frac{1}{2}$
Average duration of labor in small type	24 $\frac{1}{2}$
<i>Anthropoid type series</i>	
Average duration of labor for the series	13 $\frac{1}{2}$
Average duration of labor in large type	4 $\frac{1}{2}$
Average duration of labor in small type	12 $\frac{1}{2}$

#### OCCIPITOPOSTERIOR POSITIONS

In 1932, I called attention to the intimate association between occipitoposterior varieties and the "transversely contracted" (round and anthropoid type) pelvises, and reviewed 16 consecutive cases in which occipitoposterior positions had occurred, consecutively. An analysis of these cases according to the classification given shows the types of pelvis presented:

Average anthropoid type	4
Large anthropoid type	1
Average round type	8
Small round type	2
Small female type with slight asymmetry	1

In the paper noted above the statement was made that "transverse contractions of the



low are usually limited to rectal touch. It is obvious that many occipitoposterior positions may be thus overlooked, particularly early in labor when the cervix is but partially dilated. Secondly, many patients do not enter the hospital until well advanced in labor, and when seen by the examiner spontaneous internal rotation will have already taken place.

#### CONCLUSIONS

The present study of the pelvis in 135 primiparous women, 100 of whom have been delivered, emphasizes the following:

- 1 The incidence of anatomical variations of the pelvis is of frequent and significant occurrence. In this group the so called "normal" female pelvis of other classifications occurred in but 52 per cent of cases.
- 2 Because of the frequency of the incidence of anatomical variations, a simple, working classification is necessary and the one presented here is both simple and descriptive in its nomenclature.
- 3 An accurate and practical survey of the female bony pelvis should include roentgen pelvimetry of the pelvic inlet and external

- 4 The incidence of occipitoposterior position early in labor is undoubtedly greater than is generally believed. In certain of the pelvic variations such as the anthropoid type it is unusually high.
- 5 The important role played by the shape of the superior strait in the production of occipitoposterior position is again emphasized in every primiparous woman as again demonstrated. The practice of scientific obstetrics presumes a knowledge of all the facts that are essential for the successful outcome of labor and the important part played by the size and shape of the bony pelvis needs no emphasis.

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pelvic inlet, either real or relative are far more frequent than hitherto supposed and have a most important place in occipitoposterior positions. In the following year I pointed out that actual or relative shortening of the transverse diameter of the superior strait results in a limitation of space that is relatively greater in the anterior than in the posterior half of this plane and that under these circumstances it seems obvious that the occiput in its descent will enter the pelvis in its posterior half. This viewpoint was substantiated by the opinion of Caldwell and Moloy who state that "in the anthropoid type of pelvis, engagement is possible only in the anteroposterior diameter as compensation exists in the posterior pelvis, the anterior part of the inlet being narrow". Several observers have pointed out that early in labor an occipitoposterior position is more common than is generally recognized. Thus Potter (3), "who, because of his unusual technique of delivery by version and extraction, makes vaginal examinations early in labor, reports in a series of 515 cases an occipitoposterior position in 166 or 32 per cent (2) in a recent review of 1,565 cases. My own opinion is that in certain varieties of pelvis such as the anthropoid, round, small female, and flat female types the incidence of this position is very high and that the general incidence early in labor is somewhere between 35 and 50 per cent.

The incidence of occipitoposterior position in pelvis of the small female type and the flat female type as noted in 4 cases of the present series deserves comment. In the former the shape of the superior strait usually approximates that seen in the small round pelvis which, I am convinced, favors occipitoposterior position, while in the flat female type the abnormal projection forward of the sacral promontory which characterizes this variety, unquestionably forces the occiput to occupy the posterior half of the pelvis.

The query may well be made as to why in the present series, occipitoposterior position early in labor does not show greater incidence. A number of factors may explain this. In the first place these patients were delivered by the house staff, whose examinations from be-

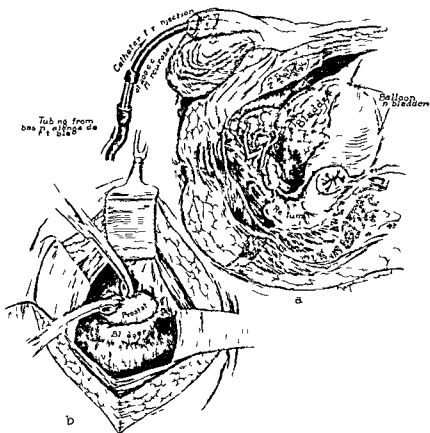


FIG. 2 Drawing to illustrate the exposure by blunt dissection of the prevesical space anterior surface of the prostate and membranous portion of the urethra. Distention of the bladder by the balloon and plugging of the urethra by the catheter help very much in this dissection. a Shows the general anatomical relationships with the bladder distended and the catheter in place. b Illustrates how the membranous urethra is opened after it has been isolated and the contained catheter is clamped and divided.

*Cystectomy, a Method of Retroprostatectomy Vesiculectomy* —Frank Hanman

# CLINICAL SURGERY

FROM THE UNIVERSITY OF CALIFORNIA HOSPITAL

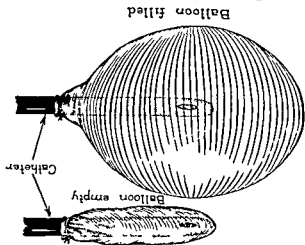
## CYSTECTOMY, A METHOD OF RETROPROSTATOSEXUAL VESICULOCYSTECTOMY

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I CAN find very few descriptions of the operation of cystectomy. The removal of an ex-strophic bladder requires no particular technique. The removal of a malignant bladder, however, is a different matter. The malignant bladder should be removed intact, unopened, and with the least possible manipulation. Drainage of the pelvic space afterward is equally important, as pointed out by the late R. C. Coffey.

There are two routes by which the bladder can be removed—the perineal and the suprapubic. The perineal route is indicated in men with carcinoma of the trigone or neck of the bladder associated with involvement of the prostate, either of which may have been primary. (The vaginal route is indicated in women with cancer of the urethra and vagina.) When this involvement is extensive and the man's pelvis is "frozen with cancer," the condition probably is inoperable. Such cancers can be removed completely neither suprapubically nor perineally, and radical surgery should not be attempted. In less advanced conditions, radical removal is possible. When involved, the prostate and vesicles can be freed from the rectum more easily through the perineum than suprapubically.

When the prostate and vesicles are uninvolved, or only slightly so, their removal with the bladder by the method to be described is much easier through the abdomen than through the perineum. Some patients with associated vesical and prostatic involvement can be operated on to advantage by a combination of the two routes, freeing of the prostate and vesicles perineally and then enucleation of the bladder, prostate, and vesicles as one mass, suprapubically. The suprapubic route is commonly employed for cystectomy in cancer of the bladder, the usual procedure being to free the fundus of peritoneum, isolate the vesical arteries and ligate them and then peel the bladder from the vesicles and prostate.



The following method is indicated for those cases of primary cancer of the bladder which require total cystectomy and in which the urine has been diverted (uretero-intestinal implantation) in order that this might be done. In all cases of this type, even though the neck of the bladder and the prostate are not invaded apparently, the radical removal of the bladder, prostate and vesicles intact will insure more completely the removal of all the cancer. The method is retrograde as compared to the suprapubic procedure in common use and, aside from certain advantages of technique, has the additional advantage of the least possible manipulation of the bladder.

*Description of the method of retrocystectomy.* The bladder is washed out and left empty. A special balloon catheter (Fig. 1) is passed well up into the bladder, 200 cubic centimeters of mercurosal (or air if preferred) is injected into the balloon and the catheter is connected with tubing which is clamped off in a basin alongside the table so

Fig. 1. Drawing of a home made catheter balloon. A finger cot or the finger of a surgeon's glove is tied over the end of a No. 22 or 24 soft rubber urethral catheter.

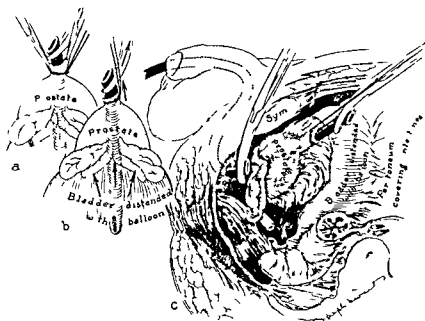


Fig 3 Illustrates how the balloon and catheter are used for traction a Urethral and prostatic tissues tied to catheter by circular ligature of heavy silk b Shows how traction on clamp and ligature lifts the balloon and neck of the bladder c Shows how the prostate and vesicles can be peeled back by blunt dissection when traction is made on the catheter and balloon

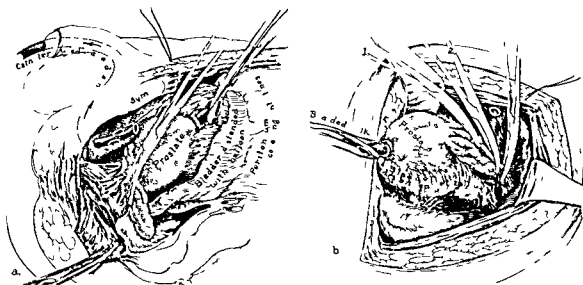


Fig 4 Drawing which illustrates the complete freeing of the prostate and vesicles a View from the side The vas and vessels on the left side have been clamped and divided b View from above The clamps (No 2) have been placed on the vesical vessels of the right side Clamp No 1 is on the vas

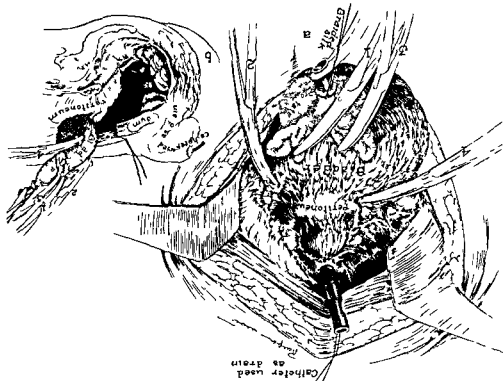


Fig. 5 Drawing which illustrates the bladder completely isolated except for peritoneal and uterine attachments. a, View from above showing the four clamps in place on the specimen and the corresponding partner removed after the vas and uterus had been ligated en masse as shown in the depths of the field. b, Side view showing the only remaining attachment of the bladder to the uterus and neighboring peritoneum.

that a nurse can empty or fill the balloon (when the surgeon desires) and thus collapse or distend the bladder.

The suprapubic incision need not be long (4

inches). The long scar of the previous operation (ureteral implantation) is excised for about half its

length. The fascia and muscles are divided in the

area of the scar down to the prevesical fat. (Care

is taken not to open into the peritoneal cavity.) The space of Retzius is opened by blunt dis-

section with the finger, exposing the anterior sur-

face of the prostate and bladder. The lower an-

terior lateral wall of the bladder is freed similarly

By dissecting under the pubic arch, the apex of

the prostate is localized. (There should be no

bleeding.) Following the capsular surface of the

prostate at the apex around each side enables one

to free completely and encircle with the finger the

membranous portion of the urethra. This must

be done carefully, well up under the symphysis

and at the apex of the prostate because the rec-

turn may be perforated easily by the tip of a

finger forced behind the prostate in the wrong

line of cleavage. The catheter outlines the urethra

and aids in making this dissection. When the

apex of the prostate and the adjacent portion of

liver is incised and this vesicle is freed and de-

livered. The right vas and its vessels are isolated,

on each side. The fascial layer covering the right

area of attachment of the seminal vesicle and vas

Denonvillier, just as in perineal prostatectomy,

In the plane of separation of the fascia of

give good traction. (Fig. 3, b and c.)

the clamp on the catheter so that the two together

(Fig. 3, a), the ends of which are tied to the

the catheter by a circular ligature of heavy silk

catheter by clamps on each side and anchored to

and apex of the prostate are pulled up on the

purpose be fully accomplished, the urethral tissues

balloon is used for traction and in order that this

The clamp on the proximal end attached to the

(Note discussion of this point under drainage.)

drainage tube after the bladder has been removed

serv, after being perforated in a few places, as a

catheter can be pulled well into the pelvis to

braded silk suture by which this cut end of the

The clamp on the distal end is replaced by a

(as is the catheter) between the clamps (Fig. 2)

in it is doubly clamped and then divided

be encircled with the finger, the urethra (with the

the membranous urethra are free so that they can

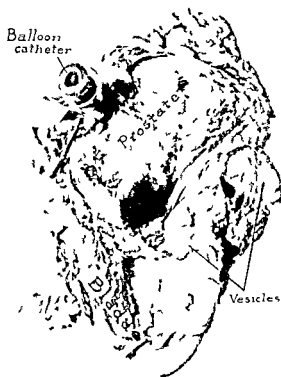


FIG. 6 Photograph of prostate, vesicles and bladder with balloon-catheter in place just as they were removed at operation intact and unopened

doubly clamped and divided between the clamps (Fig. 4)

The right vascular pedicle of the bladder with the ureter now is isolated by blunt finger dissection and is divided *en masse* between the clamps. The left vas and vesicle and the left vascular pedicle and ureter are clamped and divided similarly. This leaves all the blood vessels which supplied the bladder in the four clamps. The pedicle in the distal one of each pair of clamps is

ligated and the clamp is removed. The proximal clamps are left on (Fig. 5).

The bladder now is attached only to the peritoneum and urachus. The former can be stripped off from below upward with moist gauze, to the point of the attachment of the urachus which is clamped and divided (Fig. 5), completely freeing the unopened bladder. In case the peritoneum is adherent to the bladder because of cancer or inflammation, an elliptical area of peritoneum around the site of adhesions can be removed with the bladder, and this opening into the peritoneal cavity can be closed without risk of contamination since the bladder has been left intact and unopened.

Drainage of the pelvic cavity, left by the removal of the prostate, vesicles and bladder, should be thorough. Otherwise an abscess may develop in a blind pocket somewhere and lead to septicæmia, as happened in one of my patients. Once the urethral catheter, which has been left for drainage (Fig. 5), has been removed, it should not be reinserted. I am not sure that leaving this catheter in originally is not a mistake. It might be preferable to close tightly by suture the open end of the urethra and rely altogether upon supra-pubic drains. A perineal drain can be placed easily and gives the advantage of dependent as well as through and through drainage. Subsequent contamination of the pelvic dead space from the urethra or by way of it is likely after the catheter has been removed. This seems to be what happened in the patient just mentioned who developed septicæmia. This man of 72 was in excellent condition for 2 weeks after cystectomy and was up and about after the eighth day. An abscess formed in the pelvis extraperitoneally about this time and he died of septicæmia 3 weeks after operation. Autopsy showed that the cancer had been radically removed. The specimen is shown in Figure 6.

## TRANSPLANTATION NEPHRECTOMY FOR MALIGNANT TUMORS OF THE KIDNEY

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the operation with a feeling of hopefulness which was unknown two years ago

## THE OPERATION

The final result depends upon one thing—the successful removal of the tumor, for we have seen no instance in which radium or the roentgen ray has entirely eliminated a large mass. Now that we have found a means of increasing the operability of these tumors, the opportunity and responsibility of the surgeon have become even more significant. For this reason, it is imperative that we should review the operative technique of nephrectomy, to see whether it fulfills the demands of our new opportunity.

*The surgical principle of the operation.* In operating upon a renal tumor, we have certain very definite objectives. Perhaps we may more clearly realize their importance if we consider for a moment the general pathological characteristics of these tumors.

In the first place, they are made up of a mass of friable, malignant tissue which is in intimate contact with vascular spaces. At times, parts of the tumor actually protrude into the blood stream within a capillary or a large venous trunk. In many types, moreover, this tissue is characterized by transplantable, and it bits of it are spilled in the operative wound, they grow like weeds. These tumors are also highly vascular and often have abnormally placed blood vessels. They are frequently adherent, grow very large and have thin, delicate capsules. These are some of the factors that in the past have made the surgery of renal tumors almost a hopeless proposition. It is for these reasons that nephrectomy has so frequently been followed by a local recurrence and a shower of metastases.

On the contrary, however, these tumors have certain characteristics that make them amenable to treatment. In the first place, they seem to metastasize late, for the majority of cases show no secondary growths when they reach the surgeon. Then, again, local invasion is rather uncommon, for the tumor usually remains within its capsule even though it may fill the whole flank. Also, most of these tumors are highly sensitive to the roentgen ray and will shrink like magic if they are treated intensively. They can, moreover, be

changed. A new suggestion of hopeful forward malignant renal neoplasms has been introduced. This is because we have learned that massive renal tumors can be made operable by deep roentgen ray therapy. In our experience this applies generally both to Gravitz and Wilms embryoma, and to perinephroma. We have discovered also that other tumors, of unusual and bizarre morphology, such as cystic carcinoma, may respond in a manner which makes their preoperative irradiation worth while.

The effects of irradiation on the gross and histological characteristics of these tumors and the concomitant physical benefit to the patient have been reported by us elsewhere. Waters, Lewis and Trott likewise have presented their experience and our clinical conclusions and recommendations coincide.

The salient point of these studies is that the operability of massive renal neoplasms has been vastly increased and the operative mortality reduced. Thus, by preoperative irradiation, a ray sensitive tumor which fills three-fourths of the abdomen may be so reduced that it is hardly palpable. In many instances, with the shrinking of the tumor, the hematoma ceases or becomes negligible. During the 3 or 4 weeks required for the course of preoperative irradiation, moreover, we have an excellent opportunity actually to accomplish something in building up the physical condition and increasing the resistance of these patients. The disappearance of the abdominal mass and the cessation of hematuration makes this possible. Consequently, in many cases, by the time the course of irradiation is completed, it is found that the patient may be safely placed in a fair condition and the tumor may be safely removed.

It is thus evident that we have entirely revised our preoperative regimen since we have discovered the value of preoperative irradiation. Now we have certain definite objects in view, and in the majority of instances, have some hope of attaining them. Whenever we are successful, a great deal of the dread and frightfulness that formerly attended the removal of big malignant renal tumors disappears. In these cases, we approach

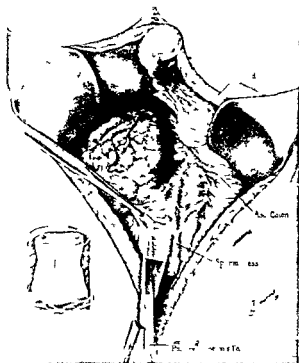


Fig. 1 The landmarks and exposure in transperitoneal nephrectomy. The illustration shows the right side which is more complicated than the left. The abdominal incision must be large and the patient completely relaxed. The posterior peritoneum is incised at some distance from the kidney and the colon in an avascular spot. The mobilization of the peritoneum is continued carefully until one gets an exposure like that shown in Figure 2.

recognized with accuracy by cystoscopic and urographic study. These factors are distinctly favorable and it is only by taking full advantage of them that we have any chance whatever of removing these tumors successfully.

With this picture in mind it is not hard to formulate an ideal nephrectomy. Such a procedure would allow us to isolate the tumor from its vascular connections before handling the friable mass. By so doing one would avoid massaging particles of the tumor into the blood stream. This would minimize the chance of metastasis. The ideal approach would also give us such wide exposure that we could see the entire blood supply, including aberrant vessels, thus lessening the risk of hemorrhage. Also it would furnish enough room to permit the removal of the entire mass intact without rupturing its capsule. This would tend to prevent local recurrence. How do our present methods of performing nephrectomy meet these demands?

There are two available types of operation: the lumbar or extraperitoneal, and the abdominal or

transperitoneal. Of these, the lumbar is by far the most generally used, not only for renal tumors but for all operations on the kidney. Undoubtedly, we all agree that it is the rational method of attacking almost all surgical problems of the kidney because it is extraperitoneal, avoids unnecessary shock and minimizes the chance of peritonitis. But is it the method of choice in operating upon renal tumors? Does it meet the requirements which we must fulfill if we would remove these neoplasms successfully?

Clinical experience and anatomical studies indicate that lumbar nephrectomy violates every one of these principles. Lumbar nephrectomy compels one to attack the tumor before he controls its blood supply. By this approach, the mass must be widely mobilized and manipulated before the renal pedicle can be seen or ligated. Aberrant vessels are often not recognized until they bleed because they lie on the median side of the mass. The last structure to be seen and controlled is the vital renal pedicle, whereas it should be the first. The excessive manipulation required by lumbar nephrectomy has in the past resulted in the operative rupture of one third of these tumors. This immediately makes the prognosis practically hopeless. Furthermore, in many of the extraperitoneal nephrectomies, the peritoneal cavity is opened more or less widely, although unintentionally, thus immediately cancelling one of the benefits of this particular approach. Our records of operative mortality and end results show that, even when dealing with small tumors lumbar nephrectomy has fallen far short of the objects we seek.

Fortunately, it is not the only procedure at our disposal. The alternate operation is transperitoneal nephrectomy.

*The advantages of transperitoneal nephrectomy.* These are definite. In the first place, the generous abdominal incision enables one to see the tumor clearly and to expose and ligate the renal vessels before one handles or moves the malignant mass. Aberrant vessels can be controlled because one can see the entire flank. Furthermore, the exposure allows one to remove not only the mass and the kidney intact but also the surrounding tissues, the capsule of Gerota, the perirenal fat and areolar tissue and as much of the ureter as one wishes. In theory, therefore, the operation is based on sound principles of surgery and pathology.

Furthermore these principles are not new or radical. They have been advocated for many years. In 1903, Walker recommended transperitoneal ligation of the renal pedicle as the first step preliminary to nephrectomy by the lumbar



route At that time he stated that he had never seen or heard of transperitoneal nephrectomy nine years later, in 1914, J. M. T. Finney described a small hypernephroma and the nephrectomy for a small hypernephroma and the tumors of the kidney should be removed transperitoneally, although he described a surgical technique which we believe to be unnecessarily complicated and which we shall discuss later. We do not know whether he still uses that technique. Most of the recent textbooks on general surgery state without reservation that renal tumors should be removed transperitoneally.

In view of the widespread approval of the principle of transperitoneal nephrectomy, and in view of the known shortcomings of lumbar nephrectomy, there must be some very real explanation for the fact that lumbar nephrectomy continues to be the method which is most commonly used.

The chief reason is probably the question of operative technique. Although transperitoneal nephrectomy is recommended in practically all modern surgical texts, it is described in very few of them, and in none is there an illustration which would in any way help one to visualize the steps of the operation. Furthermore, the technique which is often recommended is unnecessarily complicated and presupposes an anatomical familiarity with the upper abdomen which is possessed by practically no urologists, very few gynecologists and not all general surgeons. The method often recommended involves the identification and mobilization of the duodenum, the jejunum or the ligament of Treitz, and eventually, by the use of these landmarks, the location and ligation of the renal pedicle. Most of the renal surgery in this country is done by urologists and gynecologists, and to men in these specialties the upper abdomen is rather unfamiliar ground. Obviously, an operation thus designed could never be generally adopted. Indeed, it would be hazardous for the average gynecologist or urologist to attempt it. Realizing this unsatisfactory state of affairs, when Kelly and Burnam wrote their classic two volume text on *Diseases of the Kidneys*, *Ureters and Bladder* in 1915, they dismissed the whole subject of transperitoneal nephrectomy in one short paragraph, condemning the procedure unceremoniously. We hold the same opinion of the highly complicated operations that are often recommended. As we shall show, however, these technical complications are entirely needless because transperitoneal nephrectomy can be made a very simple and safe operation.

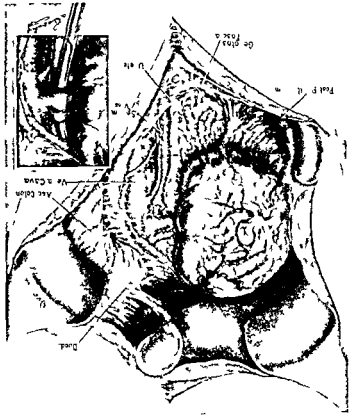


Fig. 2 The exposure of the renal pedicle. The mobilization of the peritoneum carries out of the operative field the vena cava and the renal vessels. The artist does not exaggerate the clearness of the view. By this technique one obtains complete control of the blood supply of the renal neoplasms with very little manipulation. It may not be necessary to expose the vena cava. With such exposure one can devote his attention to the removal of the tumor with a wide margin of surrounding tissue. The control of the blood supply is usually a simple problem. One can also remove as much of the ureter as is necessary.

Less valid is the objection that the operation involves opening the peritoneal cavity. If, in this instance, we had the choice between two equally satisfactory operations, one extraperitoneal and the other intraperitoneal, it would certainly be good judgment to use the extraperitoneal route. But in this case the extraperitoneal approach is fundamentally faulty whereas the transperitoneal route gives us at least an opportunity to handle the surgical problem in a safe and scientific manner. The experienced surgeon would much prefer a wide transperitoneal view of a dangerous situation to a cramped extraperitoneal peep at it. We do not underestimate the fact that a transperitoneal operation introduces factors which one does not consider when the peritoneum is not opened. We dismiss the question of peritonitis, because we do not recommend this operation for infected kidneys, except in rare situations. For the transperitoneal operation, however, the

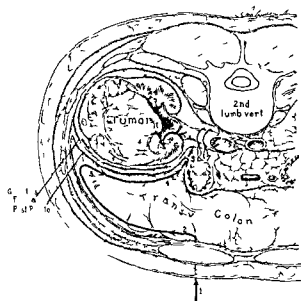


FIG. 3. A cross section of the abdomen at the level of the kidney. This shows the regional anatomy involved in transperitoneal nephrectomy. The heavy black line indicates the steps of the operation: 1. The abdominal incision; 2. the pushing of the large and small intestines out of the flank into the opposite half of the abdomen; 3. the incision in the posterior peritoneum mobilizing the duodenum and the large intestine; 4 and 5 the ligation of the renal pedicle. The relation of the perirenal fascia (Gerota's capsule) and the posterior peritoneum is clearly shown. The drawing also explains why it is so easy to get into the peritoneum during a lumbar nephrectomy unless one opens the perirenal fascia posteriorly.

This and the following cross section of the regional anatomy of the kidney also give a clear picture of the planes of cleavage that may be followed in nephrectomy. There are three: 1. the plane external to Gerota's fascia (the perirenal fascia); 2. the plane between the perirenal fascia and the true renal capsule; 3. the true renal capsule. Usually the easiest plane is found between the true renal capsule and the layer of perirenal fascia. Obviously when operating for malignant condition one wants to stay as far away from the kidney as possible. We have found it easier to pick up a satisfactory plane of cleavage if one starts the dissection of the layers a few centimeters below the kidney rather than on the kidney itself.

anæsthetic must be deeper and the relaxation more complete if one is to move the intestines out of the operative field easily and quickly. The opening of the peritoneal cavity probably increases the chance of pulmonary complications as Overholt and Churchill and McNeill have shown.

Fully appreciating these facts, we nevertheless agree with those surgeons who think that the advantages of transperitoneal nephrectomy far outweigh the disadvantages and we believe that those who will master the simple technique which we describe will be led to agree with us. Fortunately, our experience is not the only basis for

recommending this method of transperitoneal nephrectomy, for, with individual variations, this general technique has been used by our surgical associates for years. We are glad to have this opportunity to express our appreciation of their suggestions and experience. Neither in principle nor in general plan, therefore, is this operation new or untried. We have found it necessary to study this subject originally because one will search the available literature in vain for a clear description of it. For the same reason we have thought it advisable to illustrate this technique.

In many details, the operator may find it advisable to modify the method which is shown. Indeed rarely do we ligate the renal pedicle twice in precisely the same manner, and the method of handling the ureter will vary with the situation at hand. In general, however, the method of exposing the kidney and renal pedicle is likely to be fairly constant. It will be seen that this operation presupposes no familiarity with the upper abdomen, the duodenum or the ligament of Treitz. The only intraperitoneal landmark one needs to identify is the large intestine, and thorough mobilization of the hepatic and splenic flexure moves out of the field of operation the duodenum and all adjacent retroperitoneal structures. This enables one to expose the renal vessels and also the aorta and vena cava if one finds it necessary. We have removed some fairly large tumors by this approach and have found the operation simpler and safer than the lumbar procedure.

In presenting this study of operative technique moreover, we are indebted not only to our surgical associates, but also to the artist and student of anatomy Mr. Max Broedel. The accompanying illustrations were made under his guidance in his department by Mr. Leon Schlossberg, one of his pupils.

#### THE TECHNIQUE OF TRANSPERITONEAL NEPHRECTOMY

*Step 1. The incision.* We use a long rectus incision. Since we have been able to reduce the size of renal tumors by pre-operative irradiation, we have not found it necessary to make a right angle extension of this incision into the flank, although we would not hesitate to do so if we needed the additional room.

At the onset of the operation, one or two provisions are helpful. In the first place, it improves exposure to hyperextend the back as in an operation upon the gall bladder. Then, the anæsthetic must be fairly deep, if one is to push the intestines across into the opposite half of the abdomen.

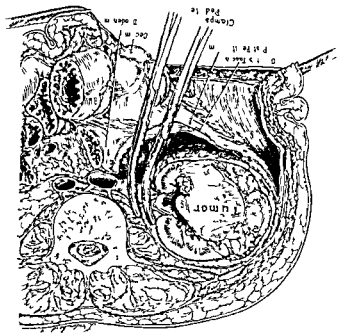


Fig. 4. A cross section view of transperitoneal nephrectomy. This shows how completely the large intestine and the duodenum are eliminated from the operative field by this technique. We make it a practice to remove Cetera's peritoneal fascia with the tumor.

*Step 4. Ligation of the renal pedicle.* This is the most important step in the whole operation. In order to expose the renal vessels clearly, it may often be advantageous to mobilize the lower pole of the kidney. This can be done gently, without moving the kidney in its retroperitoneal bed. It is always necessary to push the peritoneum and all other structures away from the region of the renal pedicle before attempting to isolate it. If one follows this simple rule, he will never have to fear injuring the duodenum, or any other adjacent structure. In all cases, the operator should get a clear view of the renal artery and veins, also he will often see the aorta and vena cava as well.

The renal vessels are usually buried or covered by a layer of fat. They can be located in several ways. By palpation, one can feel their pulsation. Their relation to the renal hilum usually points them out. Then, again, the ureter leads directly to the renal pelvis.

As a rule, there is no difficulty whatever in locating not only the renal vessels, but also aberrant arteries and the ovarian or spermatic vein. Before clamping and controlling the renal artery and veins, it is always wise to expose them thoroughly, removing the fat and areolar tissue elevated from the bed in which they lie so that a ligature may be passed around them. This procedure is done carefully and under full vision

One can waste a great deal of time and increase the surgical shock by trying to pack away the intestines before relaxation is complete.

*Step 2. The exposure of the tumor.* As the illustrations show, the operator works directly across the peritoneal cavity. The hyperelevation of the back, however, brings the lumbar wall nearer to the surface, and the big incision makes it entirely unnecessary to work in a hole. In fact, one should feel a distinct sense of roominess which gives one confidence and ease.

After the intestines have been pushed into the opposite half of the abdomen, one is brought immediately to the posterior abdominal wall. The large fossa one sees the bulging caused by the kidney mass. These are the landmarks.

*Step 3. The layer of posterior peritoneum is now incised.* This is also a very simple step. The incision in the posterior peritoneum should be made at least 2.5 centimeters from the lateral margin of the large bowel, so that one will not injure it and have a wide flap of peritoneum for easy approximation afterward.

I find that it is much easier to incise this layer of peritoneum if one mobilizes it before cutting it. One picks up the peritoneum at a clear spot, nicks it with a knife, and then by inserting the closed scissors into this opening, mobilizes the peritoneum in the line of the desired incision. This step is illustrated.

The peritoneum is thus mobilized and cut well above the flexure of the large intestine. The large back by the gauze and retractors which are already in place. The peritoneum is also pushed away from the region of the renal pedicle and the kidney. The duodenum goes with the peritoneum and ascending colon. If, by chance, the kidney tumor and the peritoneum are intimately adherent, one can leave a wide patch of peritoneum on the kidney, and remove it with the tumor. When operating upon the left kidney one does not have to think of the duodenum.

The elevation of the posterior peritoneum brings one down directly to the retroperitoneal mass. The kidney is usually visible. The renal pedicle and pelvis are hidden under a layer of loose fat. In thin persons, the ureter can often be seen, it can almost always be picked up by rolling the loose areolar tissue and fat between the fingers. It can thus be exposed easily, and it traced upward will lead directly to the renal pelvis. It is often helpful to expose the ureter to the kidney at this stage, because this procedure aids in exposing and mobilizing the renal vessels

Every surgeon will have his own particular method of preference in handling and isolating the renal pedicle, and he will probably vary it with changing demands

*Step 5. Removal of the tumor* It is essential that there should be no back bleeding from the tumor or kidney at any time, as this blood will probably contain cells of the tumor. Local recurrence is very likely if this occurs

The removal of the tumor is usually a fairly simple matter, after the blood vessels have been ligated and cut. We have not observed any unusual adhesions as the result of pre-operative irradiation. In fact the irradiated tumors are usually harder, more compact, have a thicker capsule and are definitely less friable and vascular than tumors which are not irradiated. We try to remove all of the perirenal tissue possible, including the perirenal fat, Gerota's capsule (the perirenal fascia), a long strip of the ureter and all the areolar tissue we can safely take away

*Step 6. Closure* The posterior layer of peritoneum is closed tight by a continuous suture of plain catgut. If drainage is necessary it can be provided through a stab wound extraperitoneally in the flank. We did not drain our last two transperitoneal nephrectomies and the wounds healed cleanly

The operation which we have described is usually done very easily in a little more than 1 hour, requires no pulling or tugging, entails very little shock, and in our opinion is much less risky than a lumbar nephrectomy for tumor

#### CONCLUSIONS

We have described and illustrated the steps of a simple method of performing transperitoneal nephrectomy. We present this because of the current opinion that transperitoneal nephrectomy is a dangerous and complicated operation and because this particular technique has not been illustrated in the available literature. It is our

opinion and the opinion of many other surgeons that transperitoneal nephrectomy is far safer than lumbar nephrectomy for the removal of renal tumors

We present this as part of a study of renal tumors. In another communication we outlined our experience with the pre-operative irradiation of malignant renal tumors. We have found that pre-operative irradiation makes many of these big tumors operable by reducing their size remarkably. It has also been our experience that in transperitoneal nephrectomy we have a surgical technique which gives us a chance to remove these tumors with fair safety and with a minimum likelihood of rupturing the mass. We cannot venture an opinion as to the effect this method of treatment will have on the number of permanent cures. We do know, however, that the first step is the successful removal of the tumor and in this communication we have outlined two procedures which have helped us to accomplish this step

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LYMPHANGIOMATA OF THE GREAT OMENTUM

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ABDOMINAL tumors are not common in children. The most frequent and generally recognized types at this age are neoplasms involving the kidney and ovary. Among the rarer forms are the lymphangiomata of the great omentum. These tumors occur very infrequently and the cases are somewhat of a surgical and pathological curiosity. Sporadic isolated case reports appear from time to time. Stillman reported 2 cases in 1911, and included in his paper summaries of 19 other cases which had been published up to date. We have verified his sources and reviewed the literature since 1911, with reference to 2 cases recently observed at the Children's Memorial Hospital, and have found reports of 30 other cases, including 5 reported before 1911 which were omitted from Stillman's group. The total number of cases, including our own, is 53, a group which is sufficiently large to permit some statistical discussion with a view toward outlining the significant features of the general disease.

Our interest in this subject was stimulated by 2 patients who came under our observation with the following case histories

Case 1. L. B., a Polish girl, 5 years of age, entered the *Children's Memorial Hospital*, April 2, 1921. About 2 years previous, the mother had noted that the child's abdomen was gradually becoming larger. During the next 4 months the child seemed rather listless at home, played very little and had a poor appetite, but did not complain of any pain. The abdominal swelling seemed to fluctuate a little in size during this period. For the next 6 months up to time of admission, the child's condition had been rather stationary with no change in the size of the abdominal tumor or in the listless appearance of the child. However, about 5 weeks before her entrance into the hospital she began to complain of abdominal pain occurring mostly at night and causing her to cry out. There was no nausea during this period, but her mother thought that occasionally the child showed a small amount of fever. During the two previous years she had had chicken pox, whooping cough, and measles without complications. Her history otherwise was negative.

The findings on physical examination showed nothing abnormal except the abdomen which was quite prominent and had a doughy resistance but seemed to be tympanitic throughout. In the right lower quadrant in the region of McBurney's point a discrete movable mass about the size of an egg could be palpated. It was not tender and could be moved around to a distance of about 2 inches. The mass felt distinctly like a cystic tumor. On examination of the urine showed nothing abnormal, and a decantation test was negative. The examination of the blood showed hemoglobin of 55 per cent, red blood cells 3,360,000, and white cells 11,400 of which 50 per cent

The child developed lymphomas in her throat during convalescence. It was necessary to remove the child's tonsils before a negative thorax culture could be obtained. After that the child seemed to be in good condition so it was decided to attempt removal of the tumor mass in the abdomen by means of an exploratory laparotomy.

Operation July 18, 1937; under ether anesthesia the abdominal wall was opened by a midline incision. It was found that the mass had been palpated before operation, which was attached to and part of a large cystic tumor which occupied most of the great omentum. The mass was easily detached from the transverse colon near the splenic flexure by a broad pedicle. This was covered as close as possible to the colon and the tumor removed. For fear of interfering with the blood supply of the colon, a few small cysts were left in the pedicle when it was ligated. The abdomen was closed and the child went on to an uneventful recovery. She was discharged from the hospital in good condition on August 2, 1937.

*Pathological examination*. Report by Dr Irving J. Wolman (Fig. 2). The specimen is a large irregular tumor mass weighing about 1300 grams and measuring 16 cm. x 10 cm. x 7 cm.

[illegible]

*Histological note (Fig. 2)*  
The cyst contents stain a homogeneous pale granular matter. Their walls are formed of dyaline, relatively acellular, fibrous tissue in the form of a capsule. The wall of some cysts is more compact and thicker than others. Groups are noted within the intercysts, and also some large mononuclear cells with basophilic homogeneous cytoplasm and eccentric hyperchromatic nuclei. There is no



Fig. 3 Unilocular cystic lymphangioma of the great omentum

TABLE I—AGE OF PATIENTS AT ONSET OF SYMPTOMS

	Cases
Infancy	11
1 to 5 years	18
6 to 10 years	5
Child	1
10-20	5
21-30	5
31-40	2
41-50	3
51-60	0
Adult	3
Patients under 11 years	35
Patients over 11 years	18

It is noticeable that 35 or approximately 66 per cent, of the cases were in children under 11 years of age. In regard to the character of the lymphangiomata, 25 were unilocular, 25 multilocular, and in only 3 cases were multiple tumors present.

The cyst in most cases rested entirely free in the abdominal cavity except for the pedicle attachment. In 15 cases adhesions were found between the cyst and other structures in 6 instances to the abdominal wall in 6 to the uterus and in 1 to the intestine pancreas and inguinal canal, respectively. The tumors graded in size from the very smallest to cysts that were recorded as containing 16 quarts or weighing from 40 to 60 pounds.

The most frequent pathological complication was twisting of the pedicle of the cyst that occurred in 6 cases. Rupture of the cyst occurred in 1 case and hemorrhage into the cyst in another.

The clinical features associated with these lymphangiomata are not characteristic. Symptoms are usually slow in developing and are of long duration, the average time being 2.3 years. In a general way these cases may be grouped clinically as shown in Table II.

TABLE II—CLINICAL FEATURES OF LYMPHANGIOMATA OF THE GREAT OMENTUM

	Cases
Group 1—Symptoms due to the size of the tumor	42
A—Diffuse abdominal swelling	31
B—Localized palpable mass	9
C—Abdominal pain and distress	11
Group 2—Symptoms produced by twisting of pedicle or rupture of cyst. Clinical picture closely simulates that of appendicitis or twist of pedicle of an ovarian cyst	6
Group 3—No symptoms—Cyst discovered incidentally during abdominal operation	5

1 In the first group symptoms are due to the size of the tumor. A very large majority of the cases in this series, 42 of 53, were in this group. The most frequent clinical finding in these patients was a diffuse abdominal swelling which was present in 31. The swelling in many instances showed signs of fluid which appeared to be cystic in some cases, but was regarded as ascitic in others. The principal symptoms associated with the abdominal swellings, when they become large, were general weakness which was evident in 5 patients, dyspnea on exercise which was exhibited by 6 patients, and loss of weight which occurred in 4 patients.

Instead of a diffuse abdominal swelling a palpable local lump was present in 9 cases. In our first case, the size of the palpable mass gave a very erroneous idea of the actual size of the cystic mass. Sensory symptoms were noticeably absent in most cases in this group, but abdominal pain and distress were described by 11 patients. The pain was usually of a dull character and was present at irregular periods. Loss of appetite with or without nausea and vomiting was not infrequent.

2 The second group, in which the symptoms were produced by a twisting of the pedicle of the cyst consisted of only 6 cases. In contrast to the larger previous group, the clinical features were all indicative of an acute abdominal inflammation, resembling appendicitis, or the torsion of the pedicle of an ovarian cyst.

The clinical picture usually began with abdominal pain associated with nausea and vomiting. Abdominal tenderness, and sometimes rigidity, with moderate fever and leucocytosis were present. In one of the cases of this group the symptoms were due to a traumatic rupture of the cyst.

3 The third group was made up of 5 cases in which there were no symptoms and the cysts were discovered incidentally during operation for other abdominal conditions, usually uterine myomata.

and we have found reports of 30 more cases, not including the 2 cases of our own. The 30 cases abstracted are as follows

CASE 22 Reported by Brandt. Patient was 35 years of age, sex not stated. The patient had a freely movable abdominal tumor reaching to the navel, and the diaphragm was uninvolved. Recovery was uneventful. The wall was thin and the fluid was clear. The patient was 35 years of age, sex not stated. The patient had a freely movable abdominal tumor reaching to the navel, and the diaphragm was uninvolved. Recovery was uneventful. The wall was thin and the fluid was clear.

CASE 23 Reported by Lewis and Alford. In a female, 2 years of age, an abdominal swelling was noted in the first year of life. Physical examination showed an enlarged abdomen with circumference at navel of 64 centimeters and a fluid wave and dullness to percussion. There had been an intermittent diarrhoea since 1 month of age. The clinical diagnosis of tuberculous peritonitis was made. Operation exposed a large abdominal cyst containing 4 liters of chocolate colored fluid which was evacuated. Repair of a congenital inguinal hernia was also done. Death occurred the next day. At autopsy the large cyst theled lung, the omental lymphatics were dilated and numerous smaller cysts were found to have an endothelial lining. The omental lymphatics were dilated and numerous smaller cysts were found to have an endothelial lining. The omental lymphatics were dilated and numerous smaller cysts were found to have an endothelial lining.

The indefinite and meager clinical features and the rarity of these omental cysts tend to make the diagnosis somewhat difficult. It is not strange, therefore, that in this group of 53 cases the correct preoperative diagnosis was made in only 1 instance. A diagnostic abdominal puncture was made in 13 cases, but it did not seem to be of much assistance. It was employed in our second case and the finding of bloody fluid only served to obscure the diagnosis. The fact that 66 per cent of the cases reported have been in the age of childhood should be emphasized, as well as the comparatively symptomless character of the slow growing abdominal mass.

Tuberculous peritonitis will often be continuing unless it can be ruled out by a negative tuberculin reaction. Ovarian cysts which are not confined to the pelvis will be hard to differentiate. Mesenteric cysts, uterine myomata, and congenital cases with acute symptoms due to a twisted pedicle simulate appendicitis or torsion of an ovarian cyst so closely that differentiation will probably be impossible.

Surgical treatment was employed in all of the cases in this series except the first one on record which was reported in 1837 by Gairdner, who found an omental cyst at autopsy. Aside from the fact that some of the patients are very young, the operative procedure is relatively simple. The cyst is exposed, freed from adhesions, and removed in the same manner as an ovarian cyst. The surgical results in general were very satisfactory. Omental cysts are benign tumors and do not tend to recur after removal. The operative mortality in this series was very low as there were only 2 deaths in the 53 cases.

# SUMMARY OF CASES COLLECTED FROM THE LITERATURE

In 1911, Stillman reported 2 cases of true lymphatic cysts of the omentum and collected 19 others from the literature. These included the multicystic solitary type of cyst as well as the multicystic lymphangiomas, and were reported by Gairdner (1837), Gooding (1887), Spencer Wells (1890), Erdheim (1896), Marfan (1896), Hearn (1897), Brailmont (1898), Jacob (1901), Marsch and Klossner (1901), Schramm (1903), Boyd (1903), Schwarzenberger (1896), Young (1905), Matthews (1905), Fort (1907), Wakefield (1907), Rodman (1909), Seefisch (1909), and Gifford (1910). Details concerning the above tumors are readily available in Stillman's comprehensive article. We have reviewed the more recent literature to supplement the above list.

CASE 27 Reported by Warble and McPherson. Female adult. In the course of a hospital stay for purposes of confinement, an easily movable, painless tumor was palpated just above the fundus of the uterus between the costiform cartilage and umbilicus. After delivery a second tender, fixed mass was palpated in the left broad ligament region. At operation two separate and distinct cysts were removed from the omentum. The larger, the size of a grapefruit, lay in the right side of the pelvis, displacing and adherent to the uterus. The other, the size of an orange, was adherent to the appendix. The cysts were filled with a serous fluid, had smooth fibrous walls and were subdivided by connective tissue septa. Certain areas had undergone calcareous degeneration.

CASE 28 Reported by Warble and McPherson. Female 27 years of age. A tumor in the right inguinal region had been present since childhood. It was freely movable, painless, and easily movable. It was palpated just above the fundus of the uterus between the costiform cartilage and umbilicus. After delivery a second tender, fixed mass was palpated in the left broad ligament region. At operation two separate and distinct cysts were removed from the omentum. The larger, the size of a grapefruit, lay in the right side of the pelvis, displacing and adherent to the uterus. The other, the size of an orange, was adherent to the appendix. The cysts were filled with a serous fluid, had smooth fibrous walls and were subdivided by connective tissue septa. Certain areas had undergone calcareous degeneration.

been present since birth. This was found to be the size of a grapefruit, slightly fluctuant and gave no impulse on coughing. It was thought to be an inguinal hernia. On cutting down over the mass the operator found it to be a thin walled omental cyst which had prolapsed through the inguinal canal and was attached by a long pedicle. Through an abdominal incision the pedicle was tied off and the cyst was easily removed by way of the inguinal incision. Recovery was uneventful. The cyst wall was found composed of connective tissue principally with some round cell infiltration indicating acute inflammation.

CASE 29. Reported by Frank. Female 20 years of age. The patient had been wearing a pessary for 10 months because of uterine prolapse. Seven months ago she noticed an enlargement in the pelvis which had been gradually increasing in size. Her bowels were constipated. On examination a cystic abdominal tumor was palpable in the region of the navel and there was a protrusion of the abdomen about the size of two fists. *Per vaginam* a number of cystic nodules could be felt filling up the entire pelvis. A diagnosis of ovarian cystomata was made.

At operation a large multilocular cystic formation of the omentum was removed. In addition numerous small similar cysts were scattered on all the peritoneal surfaces the cæcum small gut mesentery uterus broad ligament tubes and ovaries. Each cyst was easily separated from its neighbor and from its attachments. Their walls were thin and they contained clear serum. A rather large cyst was found in the groin fascia external to the external inguinal ring. All the cysts had an identical microscopic appearance and were lymphangiomatous in character.

CASE 30. Reported by Funk. Female aged 17 years. An abdominal swelling was first noted 3 years earlier. The abdomen became the size of a 9 months pregnancy and produced symptoms on pressure. Operation showed a single large cyst within the substance of the omentum which was drained and then dissected. Its wall was thin regular in thickness and consisted of fibrous tissue. Internal to this capsule was a single row of flat cells. Recovery was uneventful.

CASE 31. Reported by Outerbridge. Female 14 years of age had a large uterine myoma with many adhesions in pelvis. There were numerous endothelium lined numerous small grape like cysts filled with clear fluid at omental margin with a string of smaller ones running down the center. There was a continuous gradation from the simple dilated lymphatic channels to the largest cyst. The author believed that the peri uterine adhesions blocked the lymphatic circulation and thus produced this lymphangiomatous dilatation.

CASE 32. Reported by Kenney and Mason. Female 30 years of age had had abdominal discomfort for 6 years and swelling for 2 years. No pre operative diagnosis was made. A large multilocular cystic lymphangioma of the omentum was found. Some adhesions to the parietal peritoneum were present.

CASE 33. Reported by Bloodgood. Female aged 2 years. This infant had had swelling of the abdomen for 21 months. An exploratory operation was done and a cyst in the lesser peritoneal cavity was opened and drained. The patient recovered and was well 1 year later.

CASE 34. Reported by Bloodgood. Male aged 3 years. There had been intermittent attacks of abdominal pain for 18 months with nausea and vomiting. Swelling of the abdomen resembling ascites was also present increasing rapidly during the last 6 weeks. Aspiration yielded 12 quarts of reddish fluid. At operation a large multilocular single cyst was found and removed. Twelve days later a second operation had to be done because the ligated omental stump had become gangrenous.

CASE 35. Reported by Bloodgood. A child 4 years of age had a large single lymph cyst measuring 27 by 20 by 10 centimeters removed from the omentum. In its wall other minute cysts were found. The child was well 1 year later. No clinical data is given.

CASE 36. Reported by Pylbus. Female 4 years of age. The abdomen was swollen since 9 months of age. It was tapped when she was 18 months 2 years and 4 years of age. Slightly red fluid containing cholesterol crystals was obtained. Operation showed a thin walled cyst occupying large part of abdomen. It was partially loculated and situated in the greater omentum from which it was readily stripped. The upper part peeled from greater curvature of stomach. The omentum was repaired after removal completing the anterior wall of the lesser sac. Recovery was satisfactory and the child was discharged in 2 weeks. The cyst was the size of a large soccer ball. Microscopic examination showed no epithelial lining to its wall.

CASE 37. Reported by Speese. Male 5 years of age had a sudden abdominal pain 24 hours before admission. There had been no previous symptoms. The abdomen was found distended with some tenderness and rigidity over appendiceal region. The white blood count was 20,000 with 80 per cent polymorphonuclear cells. A diagnosis of acute appendicitis was made. At operation an omental cyst containing 36 cubic centimeters of amber fluid with pedicle twisted was found in the upper right abdominal quadrant. The cyst was removed. Death from acidosis occurred the next day. At autopsy numerous small clear cysts were found in the gastrocolic and greater omentum. The cyst walls were lined with endothelium. Some of the omental lymphatics were dilated.

CASE 38. Reported by Halsted. Female 2 years of age. The child had a swollen abdomen and the diagnosis of ascites was made. When a small incision for drainage of the abdomen was made the delicate cyst wall presented itself and commenced to herniate. On further exploration a large thin walled hygroma and several smaller ones were discovered in the greater omentum and posterior mesogastrium. These were opened and drained. When the patient was seen at 24 years of age she was normal and there was no suggestion of an abdominal tumor.

CASE 39. Reported by Borschers. Male 4 years of age. Abdominal enlargement had been present since May 1918 no other symptoms. Operation was advised when the patient was first seen in October 1918 and refused. When brought back February 1919 the child had an enormous abdomen hanging like a bag. He had to sit with legs wide apart to make room for belly. The abdominal circumference was 74 centimeters or 34 inches. Abdominal puncture yielded a small amount of brownish albuminous liquid. The physical examination otherwise was negative and the von Iriguet test was negative. The diagnosis of ascites of unknown origin or cystic tumor was made. At operation a multilocular omental tumor was easily removed. Convalescence was uneventful and the child was well when seen 2 months later. The entire omentum was filled with cysts of all sizes up to an infant's head. These were supported by thick fibrous trabeculated septa many intercommunications. They contained brownish alkaline albuminous fluid which formed a sediment of fatty cells, lymphocytes cholesterol crystals and debris. The walls were made of dense nuclear connective tissue in which were many thin walled dilated vessels. Some of the cavities were lined with endothelium. There were many lymphocytes in the supporting stroma and a loose network of smooth muscle fibers.

CASE 40. Reported by Gurin. Female 39 years of age. The patient was operated on for a uterine fibroid which was found to have a twisted pedicle attached to and nour



ished by the omentum. They found many lymphatic cysts on the right side of the omentum and described the cysts as blocking of the lymphatics.

Case 41 Reported by Arzela Female, 3 years of age. Gradual swelling of the abdomen began at 1 year of age. She was brought to the hospital for frequency of urination of 3 days' duration. The abdomen was uniformly enlarged, smooth, fluctuant and dull to percussion. The diagnosis of omental or mesenteric cysts was made. At operation a pedunculated cyst measuring 17 by 26 centimeters was removed from the central region of the greater omentum. It was removed without difficulty and the child made an uneventful recovery. The tumor had a thin, transparent wall and contained clear, lemon colored watery fluid. It was lined by flattened mesothelial cells. Many blood and lymph capillaries and clumps of lymphocytes were found in the wall but no other cysts. The author attributed the cystic formation to an anomalous development of a lymph node.

Case 42 Reported by Bernader Male, 24 years of age. The patient had had an abdominal tumor for 5 months, which suddenly became painful and caused vomiting. At operation a cyst the size of an apple, with twisted pedicle, was found. The specimen was not described further.

Case 43 Reported by Lawrence Female, 3 years of age. The abdomen had been prominent since birth. There had been frequent attacks of abdominal pain for 6 months, relieved by cathartics 24 hours before admission to the hospital. She was taken ill with severe abdominal cramps. There was no vomiting, and emesis gave no relief. When abdomen was examined, she appeared prostrated with a distended abdomen which was tense, smooth, dull to percussion, and cyanotic in color. There was a leucocytosis of 12,000 cells, with 85 per cent polymorphs. At operation a large omental cyst with a twisted pedicle was found and removed. Convalescence was satisfactory. The cyst had several large communicating compartments, and was lined with endothelium.

Case 44 Reported by Ladd Female, 8 years of age. She had had for 3 months a distended abdomen which was not to percussion and presented a hard wall. Examination of the abdomen revealed a large fluctuant abdomen with numerous dilated veins, a hard mass in the upper left quadrant with pain felt on pressure and reflected to the left inguinal region and causing marked flexure of both thighs. The white blood count was 13,000 with 75 per cent polymorphonuclears. Temperature was 100.75 per cent. At operation a large multilocular cyst and several smaller ones were found within the omentum. The entire omentum was removed, it weighed 22 pounds. Convalescence was uneventful, and there was no evidence of recurrence 1 year later. Microscopic examination showed the cysts to have a lining of flattened endothelium, in addition many cavernous lymph spaces ramified through the omentum.

Case 45 Reported by Ladd Female 8 years of age. The patient had been losing weight for several months. When first seen, she complained of distended abdomen, headache, malaise, and joint and muscle pain of 5 days' duration, there had been no vomiting. Her white blood count was 10,500. There was found a large tumor mass on the right side of the abdomen which shifted to the hypogastric region. Cystoscopic examination was negative. At operation a large cyst measuring 13 by 8 by 6 centimeters was removed from the omentum. Its pedicle was twisted. Recovery was satisfactory. Microscopic examination showed a fibrous wall with a few strands of smooth muscle within it, and also some aggregations of lymphocytes. There was no epithelial lining. The pathological diagnosis was omental cyst of lymphatic origin.

Case 46 Reported by Ryan Male, 4 years of age. The abdomen had been large since birth, and was tapped at 2 years of age, when a large amount of brown fluid was

## SUMMARY

Two cases of lymphangioma of the omentum are reported in detail and 51 were found in a careful survey of the literature up to date. These tumors are true neoplasms and about two-thirds of them have occurred in children.

removed. The swelling, recurred again and respiratory embarrassment appeared. A smooth, " doughy" mass was palpable in the upper mid abdomen. Operation showed a multilocular cyst of the great omentum, forming a group of nine endothelium lined cysts with many small round fibrotic masses in their walls. Convalescence was uneventful.

Case 47 Reported by Kan Male 22 years of age. A tumor in the left hypochondrium the size of a marble was first noted 7 months earlier. This had grown rapidly to the size of an orange. Hematuria was also present for 3 months. The operation showed a cyst in folds of the great omentum which was easily peeled out. The tumor was 5 inches in diameter and contained white, milky fluid, its lining was thin and shiny. Recovery was uneventful. The blood disappeared permanently from urine 5 days after operation. No microscopic report was made.

Case 48 Reported by Howe Male infant, aged 2 years. The patient had a left inguinal hernia since 6 weeks of age. At age of 1½ years, this became irreducible and 3 weeks later was operated on. Before operation the tumor in the groin was the size of a small cocoon, fluctuant and translucent. It could be partially reduced. The diagnosis of hydrocele was made. At hernial operation a large single cyst with 20 ounces of clear, dark yellow fluid was removed, this had one small diverticulum. No microscopic description was given.

Case 49 Reported by Grausman and Jaffe Male 44 years of age. For several months, the patient had night lower abdominal pain with indistinct abdominal symptoms. On examination there was found diffuse abdominal tenderness, and a white cell count of 14,000 with 86 per cent polymorphonuclear cells. At operation a large cystic omentum was found and removed. Hundreds of cysts of varying from 1 millimeter to 2 centimeters in diameter were present. The omental lymphatics were dilated and contained clear fluid. The omental lymphatics were dilated and lymphoid cell infiltration with follicle formation had occurred.

Case 50 Reported by Fisher Male, 4 years of age. Abdominal pain and distress were present for 3 days. Examination revealed a large fluctuant abdomen with numerous dilated veins, a hard mass in the upper left quadrant with pain felt on pressure and reflected to the left inguinal region and causing marked flexure of both thighs. The white blood count was 13,000 with 75 per cent polymorphonuclears. Temperature was 100.75 per cent. At operation a large multilocular cyst and several smaller ones were found within the omentum. The entire omentum was removed, it weighed 22 pounds. Convalescence was uneventful, and there was no evidence of recurrence 1 year later. Microscopic examination showed the cysts to have a lining of flattened endothelium, in addition many cavernous lymph spaces ramified through the omentum.

Case 51 Reported by Wyat in Minnesota Male, 1931, 14 656 Female, aged 3½ years. For 2 days child had had symptoms of acute appendicitis with fever, vomiting, abdominal pain, and rigidity. At operation 1,000 cubic centimeters of green fluid was found in the abdomen. A large multilocular cyst in the great omentum measured 5 by 3 by 5 centimeters. One large chamber had ruptured. Microscopically the cysts had an endothelial lining.

The symptoms produced by these tumors are due either to their size or to twisted pedicles

They can be permanently removed by simple surgical treatment with little risk to the patient

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BRANCHIAL CARCINOMA

LATERAL CERVICAL NEOPLASM

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THE fact that less than 100 cases of branchial

genic carcinoma have been reported in the literature, and that the largest single series by Lorenz, who reports but 8 cases, makes it appear that it would be of interest to present our observations in a series of 28 cases seen by one of us at Lakeside Hospital and at the Cleveland Clinic. Although branchial carcinoma is among the most malignant lesions, and the disease is usually fatal, nevertheless, it is well to accumulate experience in the treatment of the lesion in order to find what therapeutic methods offer the best chance of relief or of temporary cure.

Branchial carcinoma was probably first described by von Volkmann, in 1882, as a tumor of the neck for which no source could be found in the skin, lymph glands, nose, mouth, pharynx, ears, or esophagus (Essentially the same factors are present in the diagnosis today). Hudson presented a series of 6 cases of "so called branchial carcinoma" in which 5 came to autopsy and revealed other sources to account for the lesion. However, in view of all the evidence available today, such a pathological entity surely exists, although its exact mode of origin is obscure.

CLINICAL PICTURE

The total number of cases of branchial carcinoma in our series is 28, all of which were studied pathologically and were definitely diagnosed. Anomalous change. For comparison with the data on malignant branchial lesions, 70 cases of benign cysts have also been studied and presented in a few of the tables. Our results closely approximate those of Shedden.

The age of occurrence of lateral cervical carcinoma, as is the case with most carcinomatous lesions, falls in the latter decades of life. Two-thirds of the patients in this series had attained the age of 50 years, while nine-tenths were more than 40 years of age. The oldest patient was aged 80 years, and the youngest was a man aged 37 years. Comparisons between the ages of occurrence of benign and malignant lesions in our series are shown in Table I and Figure 1.

Branchiogenic carcinoma seems to occur more frequently in men than in women, but no relation-

ship between incidence and the occupation of the patient could be demonstrated. There is approximately an equal distribution of lesions between the two sides of the neck, but bilateral occurrence was noted once in our series. The growth of the malignant tumors is rather rapid as compared with those of a benign nature. In the case of the malignant tumors, the longest period before the patient appeared for treatment was 3 years, with an average of about 7 months, while in the case of the cystic lesions the longest period before the patient presented himself for treatment was over 4 years. Nine-tenths of the patients with branchial carcinoma reported the speed of the growth as rapid, while only one third of those with cysts showed rapid increase in size which is seen chiefly in the younger patients (Tables II and III).

The site of branchial carcinoma is usually high in the neck below the angle of the jaw or in close proximity to the ear near the sternocleidomastoid muscle (Fig. 2). Only one patient in this group had a lesion close to the clavicle (Fig. 3). The occurrence of pain is fairly frequent and this is referred to the side of the face, back of the head, shoulder, base of the tongue, and down the arm on the affected side. In the early stages the pain usually is intermittent, but, because of the close proximity of the growth to the nerves and their early involvement, the pain soon becomes quite severe and continuous. In some cases there was a specific involvement of the seventh, eighth, and ninth nerves and in 1 case a definite Horner's syndrome was present, due, of course, to the involvement of the cervical sympathetic system. Three-fourths of the patients with carcinoma complained of pain while only one-tenth of the patients with cystic lesions had this symptom (Table IV).

Malignant branchial tumors do not have a constant size, but usually average about 3 to 4 centimeters in diameter and are very firm in consistency unless degeneration has occurred, or a cyst is also present. Usually the tumor is not fixed to the skin unless some manipulation has preceded the examination, but it is very firmly attached to the underlying structures. In the differential diagnosis it is of interest to know that the cystic lesions are seldom attached to the underlying

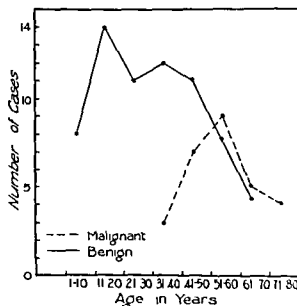


Fig. 1 Comparison of age incidence of benign and malignant branchial tumors in our series of cases

structures, and never to the skin unless they have become secondarily infected and break through.

When patients with branchial carcinoma are first seen they usually are enjoying fairly good health. About 25 per cent showed some weight loss and 50 per cent had a definite anemia. The previous health is seemingly irrelevant as most patients do not even report any previous upper respiratory infection and in only 1 case could the presence of tuberculosis be demonstrated in the pathological tissue removed. A positive Wassermann reaction was found in 1 case.

Of the patients in the series who had an ear, nose and throat examination, in only 2 was it felt that lesions which might possibly account for



Fig. 2 Lateral branchial tumor in a patient 58 years of age; duration of tumor growth 2 months. This is a typical location and shows the very rapid growth that may occur.

the tumor as a metastatic growth were demonstrable. In 1 of these cases it was thought that there was a carcinoma of the larynx, but at necropsy the growth proved to be a direct extension of the branchial carcinoma in the pyriform sinus. In the other case there was a demonstrable mass in the posterior nasopharynx, but on removal of the tumor in the neck a typical pathological lesion could be seen in a cyst wall.

In 11 of the cases in our series roentgenograms of the chest were made and in 3 definite metastases were evident. In 2 cases there were palpable inguinal and axillary lymph nodes. Roentgen examination of the skull, jaw, and oesophagus in several cases demonstrated no pathological change.

The family history is of no importance as only one patient in the group reported the occurrence of cancer in the family.

#### DIAGNOSIS

In making the differential diagnosis, all tumors of the neck, including mixed tumors, must be considered. Among the more common of these conditions is tuberculosis of the cervical glands, especially when some degenerative process is present. Usually tuberculosis occurs earlier in life than does branchial carcinoma, and there are many nodules rather than a solitary tumor. Leucæmia and Hodgkin's disease may be differentiated by blood counts. The diagnosis of a lipoma when it lies above the fascia is readily made, but when the tumor lies deep, the diagnosis is quite difficult and often the nature of the growth can not be determined until the neck is incised.

TABLE 1—AGE INCIDENCE OF BRANCHIAL LESIONS

Age in years	Benign		Malignant	
	Cases	Per cent	Cases	Per cent
10 or under	8	12		
15-30	25	38		
35-50	23	34	10	35
55-70	11	16	14	50
Over 70			4	15
Range	Newborn		37 years	
Average	50 years		58 years	
Oldest	68 years		80 years	



Fig. 3. Lateral branchial tumor in a patient 48 years of age; duration of tumor growth approximately 12 months. This photograph is included to show out one case in which the location of the lesion was atypical. The incisions which are present were made before the patient was seen here.

caused the tumor to spread to the skin, it must be sacrificed. As is true of dissection of cancer anywhere in the body, the preservation of anatomical structures should not be considered. It is most important that the dissection be made with a sharp knife, thus avoiding all traction or pulling of the tissues.

The muscular structures which should be removed are the sternocleidomastoid, thyrohyoid and other infrahyoid muscles, the rectus capitis anterior scalenus muscle.

The lymphatics are of little import and should be completely removed. There is little evidence

TABLE II—DURATION\* OF BRANCHIAL LESIONS

Shortest period	Average period	Longest period
2 weeks	4 years 6 months	34 years
20 days	7 months 2 weeks	3 years
Cysts		Carcinoma

\*Period before patient presented themselves for treatment

TABLE III—COMPARISON OF RATE OF GROWTH OF BENIGN AND MALIGNANT BRANCHIAL LESIONS

Malignant	Benign		Alteration increase and decrease in size
	Cases	Per cent	
Slow	21	37	23
Rapid	23	25	1
Per cent	7	90	3

of the occurrence of lymphoedema after the re-

Metastatic lesions may occur in the jugulo-dysphagic glands from the ear, nose, or throat, and it should be borne in mind that in chronic retro-pharyngeal abscess these glands become quite firm, hard and tender, and lymphohsarcoma also must be ruled out.

Thyroglossal cysts and adenomata of the thyroid gland must be differentiated, but these usually lie in the midline. A few of the rarer lesions such as aneurism, deep seated hemangioma, cystic hygroma, and solitary lymph cyst must be considered, but most of these conditions must be treated surgically so a definite diagnosis is not essential before operation. It should be remembered that aspiration of a branchial cyst yields a typical fluid.

### TREATMENT

The only available methods of treatment of branchial carcinoma are radiation with radium or the X-ray or both, and radical removal.

Dr. V. Portmann feels that radium can not be used in adequate doses without causing a sloughing of the great vessels which are in such intimate relation with the tumor. The tumor is resistant to roentgen therapy but this is administered to help relieve the pain. Portmann makes an attempt to keep the tissues saturated with the radiation for a considerable period of time. Short wave lengths should be used and a full erythema dose administered for one course of treatment which may be repeated once if necessary. Since branchial carcinoma is highly resistant to radiation, roentgen treatment is purely palliative.

The method of treatment employed in most of our cases has been a combination of surgery and X-ray. The pre-operative care of the patient is of little consequence except for the possibility of profound anaemia the use of blood transfusion, especially in elderly patients. Nitrous oxide anaesthesia should be employed. Local anaesthesia should be avoided as there is the possibility that infiltration into the area may spread the malignant cells.

### OPERATION

In the removal of branchial carcinoma the incision should be made over the tumor parallel to the ramus of the jaw, the middle of the incision being over the tumor. At this point, when necessary, a cut may be made parallel to the sternocleidomastoid muscle which should be long enough to give an adequate exposure. In most cases, the skin may be saved in its entirety, for usually the neoplasia has not extended to it, but in a few cases in which previous treatment has



Fig 4 Branchial tumor on the right side of the neck, duration of tumor growth 3 months. Left photograph of patient 50 years of age. Right section of tumor showing not only malignant change but a few scattered giant cells suggesting an old tuberculous infection.

removal of the lymphatic chains from both sides of the neck. The only vein of any consequence which is involved in the dissection is the deep or internal jugular. This vein has been tied and resected in so many instances that it need only be mentioned.

The important artery to be considered is the common carotid. When this is resected, anastomoses are made through the vertebral, inferior and superior thyroids and the deep cervical arteries supplying the circle of Willis. The literature shows that the mortality rate following ligation of this blood vessel is 12.5 per cent and that about 25 per cent of the patients show some subsequent mental change. The proportion of deaths and psychoses among older patients after ligation

of the common carotid is even higher, and since most patients with this disease are beyond middle life, every effort should be made in order to save this vessel.

#### OPERATIVE RESULTS

The most common immediate operative result is a collection in the wound of a large amount of serum which is troublesome because it tends to push the skin away from what is left of the underlying structures. This can be prevented by the application of large pressure dressings over this area. We use skin clips with a few black silk stays and have found that this is a very satisfactory method of closure.

Of course, as in all elderly patients, the immediate danger is that of pneumonia, and this caused 2 of the 4 postoperative deaths in our series. Of the 2 others, 1 died from shock, and the other following a laryngectomy.

In 1 of the patients in this series a postoperative psychosis developed, but there was a history of some senile change before the operation, and at the time of writing this patient is still living 3 months after operation but has shown very little mental improvement.

There usually is no difficulty in the muscular movement of the head after the immediate trauma and stiffness have subsided.

The damage to the sympathetic system is evident immediately and no improvement in this respect is ever noted. The pupil on the side operated upon is contracted and ptosis of the lid develops caused by a paralysis of Mueller's muscle resulting from the cutting of the superior cervical ganglion. When the vagus nerve is cut



Fig 5 Photomicrographs of sections of a branchial tumor removed from a patient 51 years of age, duration of tumor growth 6 weeks. Left photomicrograph  $\times 100$ . Right photomicrograph showing the definite cystic nature of the lesion  $\times 100$ .

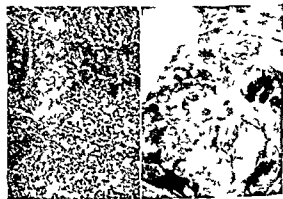


Fig 6 Photomicrographs of sections of a branchial tumor removed from a patient 56 years of age, duration of tumor growth 12 months. Left photomicrograph  $\times 100$ . Right photomicrograph showing a larger area with a cyst wall in the lower portion  $\times 90$ .

of 1 month after treatment. The fifth patient is living 4 months after the first treatment and 8 months after the lesion was first noted, and is apparently in good health.

One patient was treated with radium alone, receiving 2,340 milligram hours at the first treatment and 2,600 milligram hours 2 months later, and died 6 months after the first treatment.

Four patients were treated with both roentgen and radium radiation and all died within a period of 9 months after the first treatment. The patient who received the smallest dose of X-ray and radium lived the shortest length of time after the treatment, and the one who received the largest amount both of X-ray and radium had the next shortest survival period, the patient who received the next to the smallest dose lived the longest (9 months).

In 8 cases, not included in this series, there was a clinical diagnosis of a branchial tumor but no pathological examination. These patients received no treatment and their average duration of life after their first examination was approximately 6 months.

These data show that the results of treatment of branchial carcinoma are not good, no matter what the treatment, but in view of the fact that Koeder has reported that 1 patient treated by radical operation and roentgen radiation has survived for more than 4½ years, we feel that every patient should be subjected to these therapeutic procedures, with the hope that perhaps a few may be definitely benefited.

PATHOLOGY

The pathological picture presented by these cases of branchial carcinoma is that characteristic of squamous cell carcinoma. Grossly, if the origin of the tumor is a cyst, there is usually some evidence of the cyst wall and often a definite capsule is infiltrated by the tumor and can be demonstrated. The blood supply usually is scanty and gives rise to the frequent areas of necrosis, as well as the hyaline degeneration. Often a fatty, yellow, semisolid content typical of the cyst lining may involve only a portion of the cyst lining. At microscopic, there is a fibrous tissue stroma with the tumor cells arranged in whorls of branching cords with no evidence of connective tissue between the cells. In addition, there may be nests containing cells more densely packed together, showing typical pearl formation. The cells themselves are polyhedral in shape and irregular in size, with the nuclei taking varying amounts of stain. A frequently noted fact which

an immediate change in the rate of respiration is noted and also a rapid increase in the pulse rate. The vagus nerve on the right side of the neck is supposed to have less influence on the heart and gastro-intestinal tract than does the vagus nerve on the left, although, in our experience, the cutting of this nerve on either side produced little or no permanent effect. Most of the respiratory and cardiac changes disappeared within 24 hours.

Paralysis of the vocal cords is permanent, of course, and the patient always has some huskiness of the voice. The phrenic nerve lies beyond the structures involved and is usually avoided at operation, but, if it were cut, there might be a collapse of the lung on that side.

END RESULTS

In this series of cases, 11 patients were treated by surgery alone. Two died from postoperative bronchopneumonia. I've left the hospital, 4 of them in good condition on discharge, but the fifth was unable to swallow on account of paralysis of the glossopharyngeal nerve. Two of the remaining 9 patients died, respectively, 9 and 10 months after operation. Two are still living, 1 in very poor condition at the end of 1 month, and the other is alive at the end of 3 months with a postoperative psychosis.

Six patients were treated by surgery and post-operative deep roentgen radiation. One of these died following a large gastrectomy which was performed because of the extension of the tumor into the pylorus. Two others have died, one at the end of 3 months after operation, the other at the end of 11 months after operation following three courses of radiation over the entire side of the neck and head. Two are living at the end of 2 months after operation but 1 of these patients is in very poor condition because of metastasis to the lung and the other patient in this group is in very poor condition 4 months after operation.

One patient, who was treated with one course of roentgen radiation preceding operation, and postoperative radium, died 12 months after operation.

Another group of 5 patients was treated only with roentgen radiation distributed over the head and neck. These all received at least 1 complete course averaging about 60 per cent of an erythema dose at each treatment. Two of these patients died within 3 months, and a third lived 7 months. The fourth patient is in poor condition at the end

TABLE IV.—INCIDENCE OF PAIN WITH BRANCHIAL LESIONS

	Cysts		Carcinoma	
	Cases	Per cent	Cases	Per cent
Present	11	18	17	61
Absent	35	50	6	21
Not mentioned	16	26	5	18

is significant of rapid growth is the remarkably large number of mitotic figures, with many of them asymmetrical and bipolar. This growth, together with the poor blood supply, leads not only to gross areas of necrosis, but to numerous isolated degenerating cells and cell groups showing karyolysis and isolated groups of nuclear granules (Figs 4, 5 and 6).

## PATHOGENESIS

Branchial or branchiogenic carcinomata arise from embryonic rests which for some unknown reason are stimulated into growth. As would be expected, therefore, they frequently are associated with branchial cysts and therefore a study of the embryological etiology of branchial cysts may throw some light upon the pathogenesis of branchial carcinoma.

A brief review of the literature regarding the embryological etiology of branchial cysts shows that there are numerous hypotheses, each and every one of which seems to explain, at least in part, the presence of such abnormalities. The histological elements in these cysts, namely connective, lymphoid and epithelial tissue, are evident in the embryonic structures in all theories presented. It may be true that each has its individual application and that, when branchial carcinomata are studied, all these hypotheses must at least be considered as factors. The evidence at the present time seems to point toward Wenglowksi's theory as the most acceptable.

In 1912 Wenglowksi published one of the most important single contributions on the etiology of cervical cysts and fistulae. This has been translated by Meyer. His papers are the result of intensive work over a period of 5 years. He concluded that sufficient evidence is shown to prove that branchiogenic rests may be limited above by the jaw and below by the hyoid bone; that cysts and sinuses found outside this area along the mesial border of the sternocleidomastoid muscle and above the suprasternal notch are anomalies occurring in the so-called 'thymacopharyngeal duct'.

Christopher greeted this theory very favorably and felt that it completely abolished the branchiogenic theory regarding the origin of branchial carcinoma. Shedden was hesitant and presented a table of Wenglowksi's conclusions as criticized by Kingsley which substantiated his doubts concerning the ability of this hypothesis to explain all the abnormalities in this area.

Frazer (5) suggested that these abnormalities may be the result of "placodal cysts" or ducts, or of the ectodermal "external pharyngeal" ducts which are connected with the endodermal pouches and this author has also shown the embryological relationship between the branchial cysts and the hypoglossal nerve. Hyndman and Light suggested essentially the same idea.

Not to be forgotten are the important early contributions to this subject by Rathke, Bland Sutton and Cusset. The last 2 authors concluded that if any abnormality in growth should cause the arches to obliterate the grooves, a fistula or cyst might result and that these pathological conditions might occur at levels corresponding to the various unobliterated clefts. Another interesting hypothesis was advanced by Rahl who felt that these anomalies arise from an improper obliteration of the cervical sinuses.

## SUMMARY

1. Branchial carcinoma is a distinct pathological entity. It is comparatively rare, less than 100 cases have been reported in the literature.

2. Branchial carcinomata arise from embryonic rests which for some unknown reason are stimulated into growth.

3. Because of the rarity of this lesion and its high degree of malignancy, which demands every resource for palliation and prolongation of life, a series of 28 cases diagnosed pathologically as branchial carcinoma, is reviewed with special reference to treatment.

4. The clinical picture is described and the conditions to be considered in the differential diagnosis are listed.

5. The method of treatment by surgery and by radiation is described, and the immediate and remote results are recorded.

6. Only palliative results and the prolongation of life can be expected from any treatment, as the disease is usually rapidly fatal. From available evidence, it seems probable that radical excision followed by radiation offers the best chance of relief to the patient with branchiogenic carcinoma.

The authors wish to thank Miss Amy Rowland and Dr. Allen Graham for their assistance in producing this paper.



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## RUPTURE OF THE KIDNEY PELVIS

REVIEW OF THE LITERATURE<sup>1</sup>

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**R**UPTURE of the kidney pelvis is a relatively rare lesion of the kidney. The author has collected 61 cases of rupture of the kidney pelvis from the literature and has added 3 personal cases. In this series of 64 cases, there are 31 cases of traumatic rupture, 26 of the spontaneous type, 3 following instrumentation of the ureter and 4 following pyelography. These cases are grouped under their respective headings in the bibliography. It is possible, and indeed very probable, that many more similar cases have been encountered but have not been reported or are reported in connection with some other renal lesion i.e., ruptured hydronephrosis, renocolic fistula etc. and hence are not readily discernible in the rapidly increasing urological literature.

In this series the author has collected only those cases in which the rupture is strictly confined to the pelvis of the kidney and has excluded those cases (a) in which the rupture has occurred at a terminal calyx (Fritz, 2 cases, Henline), (b) in which an associated rupture or tear occurred in the renal parenchyma and (c) in which a peri renal abscess or vertebral abscess opened into the renal pelvis.

True rupture of the kidney pelvis may be conveniently classified into the following two types: traumatic and non traumatic or spontaneous. The traumatic type of ruptured pelvis, unassociated with a parenchymal injury, is more frequently encountered than the spontaneous type and is usually observed in those cases of ruptured hydronephrosis in which the external force is sufficient to produce an uncomplicated rupture of the thin pelvic wall found in pyelectasis. The spontaneous type of ruptured pelvis usually occurs in those patients who have associated pathology in the upper urinary tract, i.e., pyelitis or hydronephrosis secondary to an inflammatory lesion or congenital or acquired obstruction (stone stricture, etc.) of the ureter or pelvis.

## ETIOLOGY

There are various extrinsic and intrinsic factors or conditions which may serve as predisposing or etiological agents in the production of a rupture or perforation of the renal pelvis. The most common extrinsic factor is trauma of a direct or indirect nature. The most important intrinsic

factors are (1) infections of the renal pelvis, (2) stone or stricture in the pelvis or ureter, (3) hydronephrosis, (4) operative defects, (5) instrumentation, i.e., ureteral catheterization, and (6) synge pressure pyelography. While some of these conditions bear a greater etiological significance than others, a brief consideration of each is presented.

**Trauma.** The etiological relationship of trauma to rupture of the kidney parenchyma has been repeatedly emphasized by many writers. A review of the important contributions to this subject is in order since the external forces concerned in the production of a rupture of the kidney pelvis are essentially the same as those responsible for a rupture of the kidney parenchyma. Rayer and Tuffier were the first to emphasize the fact that an injury to the kidney may be caused by the jarring from a direct blow on the body. LeDentu explained kidney injuries on the same basis as a brain injury due to a blow on the opposite side (*contre coup*). Schede pointed out the possibility of throwing a distended kidney against the transverse process of a vertebra while Morris attributed a similar role to the floating ribs. Kuster has stressed the effect of hydraulic pressure acting through full blood vessels and a distended pelvis and causing the organ to burst along lines which radiate for the most part from the pelvis and tubules toward the point of maximum impact of the lower ribs, the opposing resistance being supplied by the vertebral column. Guterbock has suggested the possibility of a force so exerted that the poles of the kidneys are squeezed together producing transverse fissures and conceivably ruptures. Keen maintained that the line of cleavage follows the direction of the uriniferous tubules. Grawitz explained the tendency to radial fissuring on the basis of the fetal arrangements of the kidney but this theory lacks histological proof.

The most frequent modes of injury to the kidney parenchyma or pelvis are (1) the application of direct force against the kidney, i.e., a fall, blow or compression which drives the kidney against the lower ribs or against the transverse processes or bodies of the lumbar vertebra, (2) the application of indirect force producing a concussion such as may occur following (a) jarring the body as in landing on the feet after a fall, (b) undue muscular

to cases the rupture occurred in a pyonephrotic kidney secondarily to a calculus or stricture in the ureter or pelvis

*Stone or stricture in the upper urinary tract.* The presence of a stone in the ureter or pelvis may influence, directly or indirectly, the development of a traumatic or spontaneous rupture of the pelvis. The pathological sequelae of stone in the upper urinary tract, i. e., obstruction, retention, infection, and ulceration, are well recognized. Thus a ureteral or pelvic stone may be indirectly responsible for the rupture of the pelvis by virtue of the fact that these accompanying secondary changes in the pelvic walls increase the susceptibility of this structure to rupture following a mild or severe traumatic insult. If an infection supervenes, the thinning pelvic walls resulting from pyelocalculi are further weakened so that any extrinsic or intrinsic pressure may produce a rupture of the pelvis. In the analysis of the reported cases it was found that a stone was present at the ureteropelvic junction in 3 cases, in the ureter in 9 cases, in the pelvis or calyces in 14 cases.

A stone in the upper urinary tract may be the direct cause of a pelvic rupture. When the calculus is small, smooth, and movable, the irritation and ulceration of the mucous membrane is insignificant. If the stone is jagged with irregular jagged surfaces and in a more or less fixed position, the ulcerating processes may be more extensive and produce a localized area of necrosis which serves as an admirable site for spontaneous perforation. Should the stone be impacted or impacted, the ulceration progresses rapidly and deeply, involving all the layers of the pelvic wall, and soon results in a perforation with the escape of the pelvic contents, i. e., infected urine and occasionally the stone, into the peripelvic and perirenal tissues. Any intrinsic or extrinsic obstruction of the ureter may be indirectly responsible for a rupture of the pelvis by virtue of subsequent development of a hydronephrosis or pyonephrosis. In the case reported by Schmidt, the pelvic rupture occurred in a hydronephrotic kidney secondary to an aberrant vessel crossing the ureteropelvic junction. In one of the author's cases, a stricture at the ureteropelvic junction was the probable etiological factor responsible for the pelvic rupture.

*Hydronephrosis.* In 1909, Leguen distinguished three types of hydronephrosis associated with trauma, viz (1) true traumatic hydronephrosis—this type has all the physical characteristics of an ordinary hydronephrosis. The dilatation of the kidney pelvis occurs at the expense of the kidney parenchyma. Some traumatism. (2) The dilatation of the kidney pelvis occurs at the expense of the kidney parenchyma. Some traumatism. (3) The dilatation of the kidney pelvis occurs at the expense of the kidney parenchyma. Some traumatism.

effort as in sneezing, coughing, straining, lifting heavy objects, etc., (c) acute flexion or other sudden movements of the body, (3) penetrating forces such as a gunshot injury, stabbing, etc. The latter type is more likely to result in an injury to the parenchyma or a vascular pedicle than to the pelvis.

At times it appears to be well nigh impossible to explain the occurrence of a rupture of the kidney parenchyma or pelvis following what appears to be a slight injury or inadequate force. The extent of the damage to the renal parenchyma or pelvis may be out of proportion to the degree or amount of the force. The direction of the force and the pathological and physiological condition of the kidney parenchyma and pelvis often determine the type of injury to these structures. It is the general impression that an infection or distension of the kidney parenchyma or pelvis greatly increases the susceptibility of that organ to rupture by external violence. This is borne out by the increasing number of reports of rupture of hydronephrotic kidneys in the recent literature. In many cases of traumatic rupture of the kidney, the laceration or tear in the kidney parenchyma is very often accompanied by a considerable tear in the renal pelvis or the parenchymal rupture extends directly into the pelvis, but in such cases the pelvic rupture is always overshadowed by, and secondary in importance to, the parenchymal injury.

The etiological significance of an acute or chronic infection of the pelvic walls in the production of a traumatic or spontaneous rupture of the pelvis has not been clearly determined. The presence of such an infection, unaccompanied by a pelvic obstruction, apparently has but little causative significance in cases of rupture of the pelvis. On the other hand, a pelvic wall weakness of the pelvic walls which increases the susceptibility of the tissues to any type of injury. Undoubtedly, a pelvic infection plays a more important role in the etiology of the spontaneous type of rupture. This contention is based on the fact that a rupture of the pelvis is more likely to occur in those cases where the pelvic inflammatory process and are subjected to the influence of other factors such as an increased intrapelvic pressure or irritation from an impacted irregular stone. It can be readily understood how an ulcer with a thin base and inflamed margins may serve as a potential site for a perforation or rupture under similar conditions. Two cases of ruptured pelvis secondary to a chronic pyelonephritis were reported by Fritz and Maehle. In

chyma and is the result of a more or less complete obstruction of the ureter or pelvis by either a blood clot or a faulty reparative process in the injured kidney, pelvis or ureter, (2) pseudotraumatic hydronephrosis—this type is the result of an injury to the kidney, pelvis or ureter which is followed by an extravasation of urine, and occasionally blood, into the surrounding tissues, and by the development of a well defined sac about the extravasate. This condition is sometimes called pseudohydronephrosis and is seen most frequently in young individuals, and (3) ruptured hydronephrosis—in this type, a rupture of a pre-existing congenital or acquired hydronephrotic kidney occurs as the result of direct or indirect trauma.

It is the latter type (group 3) which is of particular interest from the standpoint of rupture of the kidney pelvis, for by far the greatest percentage of cases of ruptured pelvis are cases of ruptured hydronephrosis. The author has reviewed 72 cases of ruptured hydronephrosis of both the traumatic and spontaneous forms and found that in 17 cases the rupture or tear was in the mucous membrane of the pelvis. An analysis of this series of 72 cases reveals the fact that ruptured hydronephrosis is most frequently associated with direct trauma although indirect trauma and muscular action is the responsible factor in a few cases.

A very slight injury may be the cause of rupture of a hydronephrotic kidney especially in children and adolescents as occurred in Lazarus's patient who developed a tear in the renal pelvis following a glancing blow received during a basketball game. In Schmidt's case, the rupture occurred while the patient was rowing. Herman states that in about 50 per cent of the cases of ruptured hydronephrosis, the renal injury followed what appeared to be insignificant trauma or was of such mild intensity and degree that it is safe to assume that similar injury would not cause more than a superficial bruise in a normal individual.

It is interesting to note that several cases of spontaneous rupture of a hydronephrosis have been reported. In many of these so called spontaneous ruptures, it is possible and very probable that either or both the patient and the physician have overlooked some mild form of trauma. However, there are several cases of spontaneous ruptured hydronephrosis in which a traumatic factor can be eliminated but careful examination in these cases practically always reveals some secondary etiological factor, i.e., pyelitis or stone.

While it is true that mild traumata or muscular action may produce a ruptured hydronephrosis in children it is difficult to conceive how these same agents can produce the same effects in adults with hydronephrosis. It has been the experience of every urologist to frequently encounter men with very large hydronephroses who are employed at very arduous mechanical trades or at heavy manual labor requiring unusual muscular effort and considerable use of intra-abdominal pressure and who continue to work at their trades for many years without damage to their diseased kidneys. A possible explanation for the greater incidence of ruptured hydronephrosis and incidentally ruptured pelvis in children and young adults is the fact that the kidney is situated at a lower level in children as a result of the persistence of the infantile type of ptosis as pointed out by Aglave. Other predisposing factors in children are the lack of protection of the lower ribs as suggested by Gibson and the diminished amount of perinephritic fat and increased tension of the posterior parietal peritoneum in the region of the kidney as maintained by Harrigan. The abdominal musculature is better developed in adults and can help ward off or minimize the effects of traumatic forces directed against the kidney.

*Rupture of the pelvis following plastic operation.* Spontaneous rupture or perforation may occur several weeks or months after a plastic operation on the renal pelvis. The occurrence of a rupture or perforation following a plastic operation on the pelvis may be attributed to a faulty operation and is due to either a recurrence of the old obstruction or to the production of a new obstruction. In either instance there results an increased back pressure which is exerted on the potentially weakened portion of the pelvis, namely, the suture line. These untoward results were frequently encountered in the early days of conservative plastic operations on the renal pelvis and were responsible for the slow recognition accorded this deserving operative procedure. However, when the proper precautions are taken at the time of operation to insure and institute good drainage by inserting a nephrostomy tube, splinting the ureter, etc., accurate healing occurs and unpleasant accidents are avoided.

Walters recently emphasized the postoperative complications which are likely to occur following plastic operations on the renal pelvis for hydronephrosis. He stressed (1) the leakage of urine at the point of anastomosis with perirenal extravasation, (2) retention of the urine in the kidney leading to pyelonephritis or cortical

medium as has been pointed out by Hoffman, Hunner, Alathe, Hartman, Wesson, and Kindall. The syringe method of injecting the pyelographic fluid without manometric control should not be used in the diagnosis of those cases in which an impacted ureteral or pelvic calculus, chronic infection, abscess formation or tumor of the pelvis is suspected. The low pressure gravity is a safer procedure and practically devoid of the danger of perforation. In his discussion of Kindall's paper, Hunner stated that spontaneous rupture may follow even the gravity method if stricture or some other form of obstruction causes prolonged trapping of the fluid. Hoffman has reported 3 cases of perineal suppurative following the use of 5 per cent collargol as a pyelographic medium. He maintained that under increased pressure, the collargol passes into the canaliculi and thence by rupture or diffusion reaches the perineal tissues causing necrosis. In 1 case, the rupture occurred in the pelvis of a hydronephrotic kidney and spread into the peritoneal cavity. Kindall has recently reported 2 interesting cases of rupture following syringe pressure pyelograms. In 1 patient a calculus was present in the lower calyx of the kidney and a rupture of the kidney occurred and 2 days later a rupture of the kidney occurred and 2 days later a calculus in the kidney pelvis and ureter and developed a rupture of the pelvis.

PATHOLOGY

The pelvic lesion encountered at operation or autopsy may be either a laceration or a perforation on one of the surfaces of the pelvis, usually the posterior surface. Occasionally two tears may be present in the same pelvis. The laceration or tear in the pelvis is usually radial in character especially in cases of a ruptured hydronephrotic pelvis and appears to extend from a point near the ureteropelvic junction toward the hilum of the kidney in a direction corresponding to that of the uriniferous tubules. The size of a tear is more or less in proportion to the degree of back pressure and increased intrapelvic pressure causing the rupture. The nature and the direction of the pelvic laceration in these cases tends to indicate that the lesion is the result of a bursting rather than a break or crushing. This conforms with Kuster's theory on the mode of kidney rupture. A pathologically or physiologically distended kidney pelvis ruptures more easily and following a lesser degree of violence than a normal undistended kidney. Furthermore, the external type of pelvis is more susceptible to rupture than the intrarenal type. In cases of rupture of a normal

medium at or below the pelvic incision with a persisting urinary fistula from the site of pelvic anastomosis. Three done, later required a secondary nephrectomy due to persistent urinary fistula as a result of occlusion of the ureter by postoperative infection around the ureter (1 case) and pyelonephritis and cortical abscesses (2 cases).  
*Rupture of the pelvis following instrumentation of the ureter*  
 Perforation of the renal pelvis by a ureteral catheter has been known to occur in rare instances. Hunner reviewed a series of over 20,000 cystoscopic treatments of the ureter by the Kelly method and reported 21 accidents which included 12 personal cases and 9 cases occurring in the practice of his associates. An incidence of one accident in each thousand ureteral catheterizations indicates a very low morbidity. Nevertheless, it serves to emphasize the fact that this procedure may be attended by an unpleasant complication in hands of inexperienced cystoscopists. In this series of 21 cases there were 4 cases in which the perforation occurred in the pelvis or in the upper third of the ureter near the ureteropelvic junction. Wesson states that the wall of a normal ureter cannot be punctured by the ordinary ureteral catheter and maintains that it is doubtful if a diseased ureter can be perforated unless a deep ulcer is present. He pointed out that when the ordinary catheter is passed through the cystoscope and the tip of the catheter meets with the resistance of the ureteral wall, the catheter will buckle. Similar results were obtained when a maximum pressure was exerted in passing a catheter up the ureter through the bladder of freshly obtained autopsy specimens. He is of the opinion that perforation can occur if a wire stylet is used or the catheter is equipped with a wale-bone tip such as is used in the Kelly method of direct cystoscopy. In this connection, it is well to point out the danger of perforating the ureter when any one of the various metallic ureteral stone extractors is used. Wesson also showed that it is impossible to perforate the kidney capsule with an ordinary ureteral catheter.

*Rupture of the pelvis as a complication of syringe pressure pyelography*  
 One cannot stress too strongly the danger of producing a rupture of the pelvis in employing the syringe method of pyelography. Any pelvis or ureter whose walls have been weakened by the presence of a stone, chronic infection, abscess formation, tumor, etc., is a potential site for a rupture when too much pressure is exerted in injecting the pyelographic

kidney due to external violence, the parenchyma, being the softest and weakest portion of the kidney usually gives way first causing a tear which may extend into the capsule. However, if the pelvic wall has been weakened by a chronic infection or hydronephrosis, the rupture may be strictly limited to the pelvis. Occasionally, it may involve both the pelvis and the parenchyma. Spontaneous rupture of the kidney pelvis occurs only in those cases in which the pelvis has been pathologically weakened by dilatation or infection. The most common type of spontaneous rupture is rupture of the pelvis of a hydronephrosis secondary to an obstruction of the ureter or pelvis by a calculus. The rupture occurs as a result of a sudden or gradual alteration in the increased back pressure caused by an obstructive lesion in the upper urinary tract. Occasionally, a spontaneous rupture of the pelvis is caused by perforation of an impacted calculus. There have been no cases reported of spontaneous rupture secondary to a neoplasm of the renal pelvis.

Several cases have been reported in which the pelvis or ureter at the ureteropelvic junction have been partially or completely severed as a result of violence or external force directed against the distended kidney. It may be impossible to differentiate the rupture of the pelvis from a similar lesion of the upper portion of the ureter from a clinical standpoint. However, from an anatomical standpoint a tear or perforation at the ureteropelvic junction may be considered just as much a lesion of the pelvis as of the ureter. In fact, it is often impossible to determine on close inspection of the affected organ, either at operation or at autopsy, the exact location or limitation of the rupture. A careful survey of the literature reveals the fact that true intraparietal rupture of the ureter is an exceedingly rare condition.

The most striking pathological feature of ruptured pelvis is the extravasation of urine into the surrounding tissues. This condition is rarely accompanied by the extravasation of blood inasmuch as there are no end arteries in the pelvis. The presence of blood in the extravasate is indicative of rupture of the parenchyma or a laceration of one or more of the blood vessels in the hilum of the kidney. It is possible that at the time of rupture of the pelvis there may develop an intrarenal rupture in the region of the pyramids of varying degree which may be responsible for a slight amount of bleeding and the presence of a small amount of blood in the extravasate.

When the actual amount of urine escaping through the pelvic rupture or perforation is scant and the urine sterile, the tissue reaction is prompt

and localization of the extravasate may ensue with or without the subsequent formation of a circumscribed abscess in the peripelvic or perirenal tissues. If the extravasated urine is walled off and absorbed, these patients may recover without any surgical intervention and it is conceivable that cases of this type occur but are not recognized.

When the extravasation of urine is more extensive or continues for some period of time after the rupture, the tissue reaction may be less efficient particularly if the urine contains pathogenic organisms. In such a case the extravasated urine causes a diffuse inflammation in the surrounding tissues which soon results in suppuration and a rapidly progressive perirenal abscess. Occasionally, the perirenal abscess may rupture into the lung (Mathe), large bowel (Wesson), peritoneal cavity (Hammel, Rost, Kapel), or externally into the skin of the loin giving rise to the formation of a temporary or permanent fistula (Mathe, Turner, Higgins and Hicken, and one of the author's cases).

Vermooten and McKeown recently reviewed 34 cases of renal colic fistula. In 2 instances (Watson and Cunningham, Fuller), the fistula was found between the renal pelvis and the bowel. In all the other cases, the fistulous tract started in a calyx passing through the kidney substance into the bowel. They pointed out that renocolic fistulae are always secondary to long standing suppurative lesions of the kidney which, as a rule, are associated with either a chronic perinephritis or a perinephritic abscess.

The author has reviewed the cases of fistula formation between the renal pelvis and the large and small bowel or bronchi reported in the literature and has recorded them under their respective headings in the bibliography. These cases are not included in the final tabulation of true cases of ruptured pelvis due to the fact that the etiological relationship is by no means clearly established in these cases.

The immediate pathological changes occurring in the affected kidney following a pelvic rupture depends upon the condition of the kidney before the injury and the extent of the inflammatory process in the perirenal tissues following the injury. The subsequent perirenal infection may assume the characteristics of an extensive gangrenous process or a devastating phlegmon which soon involves the entire perirenal tissues. The infection may invade the kidney proper and produce many cortical abscesses or a diffuse pyelonephritis.

The permanent pathological sequelæ which may follow the rupture of the pelvis depend

## AGE AND SEX INCIDENCE

The age and sex of the patients bear no unusual significance in cases of ruptured pelvis. The age and sex act as predetermining factors only in so far as they predispose to the development of an upper urinary tract lesion which increases the susceptibility of the kidney pelvis to ruptures, i. e., the development of a congenital hydronephrosis in infants and children, the occurrence of pyelitis of pregnancy, hydronephrosis, piosis, and stone formation in women in the childbearing period. There were 4 cases of traumatic rupture in the first decade (Hawkins, 6 years, McAlpine, 7 years, Wesson, 8 years, and Martin, 8 years) and 4 cases in the second decade (Croft, 12 years, Lazarus, 15 years, Ewell, 16 years, and Rowland, 18 years). The youngest patient in the series of cases reviewed was 6 years of age (Hawkins), the oldest 77 years (author's case). The average age was 35.6 years. There were twice as many males (39 cases) as females (19 cases). This latter observation may be explained by the fact that the greatest number of cases were of the traumatic type and in this age of automobiles, trains and machinery and of competitive sports, men are subjected to greater hazards than women. The left kidney was the site of the pelvic rupture in 35 cases and the right kidney in 22 cases. There was 1 case of bilateral rupture (avulsion) reported by Osgood and Campbell.

## SYMPTOMATOLOGY

There is no definite symptom complex associated with rupture of the kidney pelvis inasmuch as the presenting symptoms may differ in the traumatic and spontaneous types of pelvic rupture. The clinical signs and symptoms associated with this condition vary and are more or less dependent upon the etiological factor producing the lesion, the associated pathological process present in the affected kidney, and the length of time elapsing until the patient first comes under observation. In general, it might be stated that the most prominent signs and symptoms of rupture of pelvis are those attributable to perineal extravasation of urine and perineal abscess formation. The symptoms of ruptured pelvis may be conveniently classed into the following two groups: general, and localized.

*General.* From a clinical standpoint, ruptures of the pelvis may be divided into an acute and chronic form. The acute group includes those cases of sudden rupture of the pelvis secondary to trauma. In the acute form, the patient appears to be acutely ill soon after the rupture has occurred as a result of the sudden escape of urine producing

upon whether or not treatment is instituted. In those patients who recover without operative intervention due to the fact that the extravasation is slight and localization with absorption takes place, there may develop a cicatrizing or sclerotic process in the perinephritic tissues which may or may not cause trouble in the future. Occasionally the reparative process in the region of the tear is faulty and there develops a stenosis which may be responsible for the further development of a hydronephrosis or even stone formation. If treatment consists solely of preliminary incision and drainage and no attention is paid to the underlying lesion, the after effects of the rupture resulting from the suppurative process in the perineal tissues may be manifested in the form of a permanent fistula, kidney atrophy, infection of the opposite kidney, parenchymatous or interstitial nephritis, or future stone formation. In cases in which the rupture of the pelvis occurs in the form of a partial or complete severance or tearing of the pelvis at the ureteropelvic junction, or in which the pelvis is completely severed from its attachments at the hilum of the kidney, primary healing is not likely to occur and there results a permanent fistula. In an occasional case, the injured tissues may heal with cicatricial contraction at the site of rupture which results in a partial or intermittent form of hydronephrosis as occurred in the case which has been reported by Bailey.

While this paper is particularly concerned with rupture of the kidney pelvis proper, it is interesting to note that rupture of the pelvis may also occur in any of its major or minor calyces. When the calyceal rupture is due to trauma, the laceration may extend partially or completely through the adjacent *parenchyma* (subcapsular rupture) which results in an extravasation of blood and urine below the true capsule of the kidney and heals with little or no permanent damage to the kidney. Occasionally the calyceal rupture results in a distention of the calyx due to an intrarenal extravasation of urine which may extend through the cortex and under the kidney capsule. This process soon becomes walled off producing a cystic dilatation whose lining appears to be a continuation of the pelvis and calyceal mucous membrane. This walled off sac is known as a pseudohydronephrosis which may later rupture as in the case reported by Babitzki. In the same manner a pseudohydronephrosis may develop following a rupture of the true pelvis. This condition occurred in 6 cases of traumatic rupture (Hawkins, Stanley, Dodge, Wildbolz, and Bretnino, 2 cases).

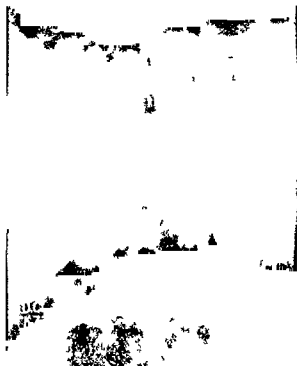


Fig 3 Case 2. Pyelogram taken in 1928. The pelvis and ureter of the upper rudimentary segment of the left double kidney have been filled with sodium iodide (13.5 per cent). The large branched calculus occupying the pelvis of the lower segment of the left kidney is clearly shown. The round shadow in the region of the upper pole of the right kidney is a calculus. A pyelogram of the right kidney which was taken several weeks later showed a moderate dilatation of the pelvis and the calculus in the terminal portion of the upper major calyx. Further pyelographic studies of the left double kidney showed a large pyonephrosis of the lower segment but the roentgenograms were too faint for photographic reproduction.

resumed as soon as the initial shock wears off. In cases of ruptured pelvis, the fact that urine is not obtained from the injured kidney may be incorrectly attributed to anuria, whereas the kidney may still retain its secretory function and urine, instead of passing down the ureter, extravasates in the perirenal tissues, and occasionally in the peritoneal cavity or bowel (Wesson, Mathe). A true unilateral anuria on the affected side may develop as a result of the pressure effect of the perirenal extravasation upon the renal pedicle.

Such urinary symptoms as urgency, frequency, dysuria, and tenesmus are uncommon. The occurrence of these symptoms would tend to indicate the presence of an associated obstructive lesion at the bladder neck or a secondary inflammatory lesion in the bladder. Haematuria is conspicuous

by its absence in cases in which the rupture is strictly confined to the pelvis in contradistinction to rupture of the parenchyma in which instance it is a very important diagnostic sign. If the rupture of pelvis is due to trauma and there is a minute intrarenal parenchymal tear or a rupture of a small intrarenal blood vessel in or near the pelvis, i.e., small blood vessel in the pyramids, haematuria may occur at the time of a rupture but soon clears up. The urinary findings are most commonly those associated with an acute progressive toxæmia, i.e., a trace of albumin, an occasional red or white blood cell and casts.

#### DIAGNOSIS

The diagnosis of ruptured pelvis is always difficult. A review of the literature reveals the fact that the majority of the reported cases remained undiagnosed until the time of operation or at autopsy due to the rarity of the condition and the uncertainty of the clinical signs and symptoms. In those few cases in which a correct pre-operative diagnosis was made, it was necessary to resort to other diagnostic measures, i.e., cystoscopy and pyelography, to establish the diagnosis.

A careful history in every case may be of inestimable assistance in directing the examiner to the possible existence of such a lesion. An antecedent history of renal colic due to stone in the ureter or pelvis is of definite significance, particularly in cases of rupture secondary to calculus obstruction of the ureter. The knowledge of the presence of an inflammatory or obstructive lesion in the upper ureter or pelvis secondary to a stone or stricture in the upper urinary tract in a patient who complains of a sudden severe pain in the renal region and presents a palpable tender mass with muscular rigidity and spasticity over the affected area, accompanied by chills, fever, nausea and vomiting, and rapidly followed by signs of collapse or a severe toxæmia, should cause the examiner to suspect a rupture of the pelvis though actually the diagnosis must be confirmed by pyelographic study or operation. It may even be impossible to establish the diagnosis when cystoscopy and pyelography are undertaken inasmuch as the offending calculus may totally occlude the ureter or ureteropelvic junction rendering it impossible to pass a ureteral catheter or inject a pyelographic medium beyond the obstruction.

Cystoscopy with bilateral ureteral catheterization has proved to be one of the most valuable diagnostic procedures available. Cystoscopic examination is often undertaken in the hope of relieving an acute renal infection or a ureteral





Fig 4 Case 2 Photograph of the left double kidney removed at autopsy. The arrow points to the perforation in the posterior aspect of pelvis of the lower segment. The large branched calculus occluding the intrarenal portion of the lower pelvis can be seen. The lower kidney segment shows the typical changes of a large multilocular pyonephrosis. The upper rudimentary segment is seen beneath the scale and shows relatively little change in the parenchyma. The small pelvis in the upper segment and a portion of partially duplicated ureters may also be seen.

interference Beach maintained that pyelography is a harmless procedure and should be employed immediately in every case of suspected kidney injury. Herman and Wallenstein emphasized its value in the diagnosis of ruptured or dronephrosis and Geisinger stressed its importance in the diagnosis of extravasation from the ureter. It is quite obvious that pyelography should never be attempted in those patients who are critically ill or in shock. In the past, the objection to pyelography was based on the supposed danger attending the injection of an irritating pyelographic medium, i.e., sodium iodide, into an injured kidney or into the perirenal tissues. Fritz and Geisinger maintain that the distribution of a small amount of sodium mercuric iodide into the tissues already infiltrated with pus and urine is not likely to be productive of any serious sequelae particularly if very low pressure (gravity method) is used in injecting the pyelographic medium. The danger of injecting an irritating electrolyte (sodium iodide) into the perirenal tissues can be readily obviated by employing 15 per cent sodium, which is non-toxic, non-irritating and non-haemolytic. Hartman and Kindall have pointed out that the usual criteria, i.e., pain and volume of pyelographic medium injected are usually insufficient to judge over-distension in a traumatized kidney where the

There appears to be a divergence of opinion as to the wisdom of employing pyelography in the diagnosis of injuries to the kidney parenchyma and pelvis. Luckert and Friedman strongly urged its use in the diagnosis of kidney injuries. They pointed out that the location and extent of kidney injury could be determined by the dissemination of the pyelographic medium within the kidney substance or outside the confines of the kidney pelvis or capsule. They also emphasized the fact that from the pyelographic findings it is possible to determine whether surgical interference is necessary without waiting for secondary symptoms or complications as an indication for such

kidney. permanent if the rupture occurs in a diseased occurs in a congenitally normal kidney and which may only be temporary if the rupture a complete loss of function in the affected kidney. The result of these tests may show renal function. The result of these tests may show a consequent intractable determination of tissues and very little passes down the ureter, perforation, the urine escapes into the perirenal nitrogen, etc. As a result of a pelvic tear or said of the value of blood urea, non protein function of the injured kidney. The same may be said of ruptured pelvis or in determining the (etc.) are of little value in establishing the diagnosis of ruptured pelvis or in determining the phosphatase, indigo carmine, methylene blue, Differential renal functional tests (phenolsul-

later date with serious consequences. postpones pyelography and operation until a result in a subsidence of fever and sepsis and hope that drainage of the infected area will the catheter in the pelvis for several days in the cases, the urologist is tempted to and does leave tive diagnostic sign of ruptured pelvis. In some renal space through the pelvic tear is a presumpt- large amount of urine aspirated from the per- affected side should be carefully observed. A amount of urine flowing from the catheter on the suspicious of a pelvic rupture. The rate and may be obtained which should make the urologist zone of extravasation, clear urine or actual pus catheter can be passed into the kidney pelvis or covered later at operation or autopsy. If the perirenal extravasation is undetermined or dis- the correct diagnosis of pelvic rupture with more serious lesion in the kidney pelvis. Thus, producing the symptoms and may overlook the into believing that the calculus is the sole lesion ureteral calculus, the urologist may be misled to reach the kidney pelvis due to an obstructing lesion is then disclosed. When the catheter fails and the true nature of the upper urinary tract block with acute retention of urine in the pelvis

dition demanding prompt and efficient treatment. *Immediate incision and drainage* of the perirenal tissues is imperative and in fact, may even be life saving in effect. After preliminary drainage has been established, the true nature of the condition or the underlying cause can be determined later or not as circumstances dictate.

Death may occur as a result of this severe infection, toxæmia, or septicæmia. If the patient survives the initial stage complications may ensue viz., the perforation of the perirenal abscess into the peritoneum, abdominal viscera or through the diaphragm, and the patient succumbs after a protracted period of wasting and suffering. The presence of an associated intra abdominal lesion or a peritoneal tear occurring at the time of the pelvic injury offers a most unfavorable prognosis. The presence of a disease process in the opposite uninjured kidney may seriously endanger the patient's life inasmuch as the injured kidney in most instances is damaged beyond repair and the entire secretory burden is thrust upon an impaired organ. As far as we have been able to ascertain, there are no cases reported in which a simultaneous bilateral rupture of the kidney pelvis occurred with the exception of Campbell's two cases, chemical necrosis following the intrapelvic injection of sodium hydroxide and bilateral avulsion of pelvis following a fall. Such an accident would almost certainly lead to an early demise.

According to Morris the prognosis in cases of rupture of the renal parenchyma, renal pelvis or ureter is less favorable than in rupture of any abdominal viscera. This pessimistic attitude may be attributed to the fact that the high mortality figures associated with rupture of any portion of the kidney in the past were based on the reports of isolated cases or series of grave cases. However, the recent refinements in urological and roentgenological diagnosis and the improvement in surgical technique have been responsible for a marked reduction of the mortality and morbidity of this condition. In the series of cases collected by the author the immediate operative mortality was 6 per cent (3 deaths in 50 operative cases), which is a very modest figure when one considers that they include cases in which preliminary drainage was delayed intentionally or non intentionally by the patient or the surgeon.

#### CASE REPORTS

**CASE 1.** N. M. a man 77 years of age an inmate of the Aged Home was admitted to the hospital on May 6, 1932 with the complaint of pain in his left kidney region. He had had a bilateral ligation of the vas deferens and a perineal prostatectomy 1 year previously with an excellent functional result. Four weeks before admission to the

hospital the patient developed a sudden sharp pain in his left lumbar region radiating to the groin. The pain persisted for several hours and was accompanied by nausea, vomiting and fever. A dull pain persisted in the left lumbar region and left upper quadrant after the first attack. The patient gave a history of nocturia (2 to 3 times), burning hesitancy and urgency but no history of passing a calculus or hæmaturia or trauma.

Physical examination was negative except for definite fullness in the left upper quadrant extending from the left flank to the mid-epigastrium. A mass about the size of a large orange was felt and appeared to be smooth and tender to touch. There was no ballottement or fluctuation. There was tenderness in the left costovertebral angle. The leucocyte count was 10,000 with 86 per cent polymorphonuclears. The urine showed 20 to 30 pus cells per high power field.

Following admission to the hospital the temperature remained slightly elevated for 4 days. Cystoscopy and pyelography were then performed. Two small calculi in the bladder were seen and removed by a rongeur. Pyelogram of the left kidney showed extravasation of dye around the pelvis of the kidney. The pelvis and calyces appeared to be dilated. A tentative diagnosis of a left pyonephrosis with a perinephritic abscess due to rupture of the pelvis was made. He was kept under observation for several days but as he continued to show a slight daily elevation in temperature and the mass appeared to be increasing in size and became more tender on palpation operative intervention was decided upon. Fourteen days after his admission to the hospital a subcapsular nephrectomy was performed under spinal anesthesia. The abscess contained approximately 3 ounces of a thick, green, foul smelling pus which was found on the posterior aspect of the lower pole of the kidney and extended around anteriorly to the region of the pelvis. Two perforations were noted in the region of the ureteropelvic junction. Culture of the pus from the abscess revealed *Bacillus pyocyaneus*. The patient had a stormy convalescence for the first few weeks after operation. The wound broke down and the patient developed furuncles in the left lumbar region culminating in a fairly large carbuncle, which responded slowly to treatment. He was discharged from the hospital 34 days after operation in good condition with the wound entirely healed except for a small sinus tract which healed 2 weeks later.

Pathological examination showed the usual changes of arteriosclerosis and pyonephrosis. The ureter was constricted at the ureteropelvic junction. Above this point of constriction there was a small perforation 3 millimeters in diameter and 2 millimeters in diameter, respectively.

It is difficult to determine the etiological factor responsible for the perforations of the pelvis and ureter in this case. It is the author's opinion that the essential pathological changes present in the affected kidney, i. e., pyonephrosis, pyelonephritis, and stricture of the ureteropelvic junction, were secondary to the benign prostatic enlargement which was removed 1 year before. The perforations in the pelvis were probably the result of increased back pressure beyond the stricture at the ureteropelvic junction. It is difficult to explain the development of the perforations below the ureteropelvic junction unless these perforations are the result of an attempt of extravasated urine and pus to drain back into the ureter.

tion of the ureter. The upper supernumerary segment of the double kidney appeared to be relatively normal on gross examination and cross section. The lower segment was a massive multilocular pyonephrosis. The pelvis of the lower segment was covered with a large amount of fibroepithelial tissue which was diffusely inflamed. At a point on the posterior surface of the pelvis corresponding to the mid portion of the lower segment there was found a perforation from which thick greenish pus exuded. On cross section of the lower segment there was a large branched calculus occupying the extrarenal portion of the pelvis of this segment. There was an area of necrosis about the perforation. The right kidney was of the hypoplastic type and showed arteriosclerotic changes.

The etiological factor responsible for the per-renal suppuration was a perforation of the chronic inflamed pelvis by a large irregular calculus. In our review of the literature we have not found a similar case of perforation of the wall of the pelvis of one segment of a double kidney. Undoubtedly, the prognosis in this case would have been more favorable if drainage of the abscess had been instituted immediately. The lack of co-operation on the part of the patient's family in consenting to an operation also contributed considerably to the fatal outcome in this case.

Case 3 J. P., 53 years of age, married, merchant, was admitted to the hospital on May 28, 1937, with the complaint of pain in the left abdomen. The past history was negative except for a chronic gastrointestinal complaint for the previous 10 years in the form of attacks of cramp-like pain in the left lower quadrant. The patient was admitted to the hospital for a thorough study and during the course of the examination was found to have some pus and red blood cells in his urine. He gave a history of occasional diurnal frequency every 1 to 1½ hours, and nocturia, 1 to 2 times, hesitancy and occasional burning on urination. There was no history of hematuria or renal colic.

Physical examination was essentially negative except for a slight tenderness in the left upper quadrant over the left kidney. A positive left ureteral point was present. The prostate was of normal size.

A complete urological study was undertaken and this closed: (1) median bar formation, and (2) left pyelonephrosis, third degree, infected and non functioning. A plastic operation on the pelvis of the left kidney was performed under spinal anesthesia. An elliptical piece of tissue was removed from the superior and inferior aspects of the pelvis and a Heinecke-Mikulicz repair was done at the uretero-pelvic junction. The patient made an uneventful recovery. About 1 month after operation a cystoscopic and pyelographic study was made and revealed a marked reduction in the size of the left pyelonephrosis with a definite restoration of function in this kidney.

Lightly days after operation he developed a sudden pain in his left loin. Four days later he had another chill and fever. Some relief was obtained by an application of heat to his left loin followed by a chill, nausea, vomiting and in his left loin followed by a chill. The abscess extended up to the diaphragm and down to the pelvic brim, but had not broken into the abscess area was emptying sinus. Then a drainage of the abscess area was provided. Due to the poor condition of the patient, it was decided not to explore the kidney or to attempt to remove the kidney. Following the operation, the patient appeared to rally somewhat, but on the third postoperative day became stuporous and semicomatose and died the following morning.

A partial autopsy was performed which disclosed a double kidney on the left side with an incomplete duplication and a partial atrophy was performed which disclosed a semicomatose and died the following morning.

On examination of the left kidney, the following findings were noted: The kidney was of normal size and shape, but had not broken into the abscess area was emptying sinus. Then a drainage of the abscess area was provided. Due to the poor condition of the patient, it was decided not to explore the kidney or to attempt to remove the kidney. Following the operation, the patient appeared to rally somewhat, but on the third postoperative day became stuporous and semicomatose and died the following morning.

A partial autopsy was performed which disclosed a double kidney on the left side with an incomplete duplication and a partial atrophy was performed which disclosed a semicomatose and died the following morning.

Case 2 K. Z., 53 years of age, a housewife, was admitted to the hospital on June 22, 1937, with the complaint of pain in the left upper quadrant. The patient gave a history of kidney colic on the right side in 1926. She subsequently developed kidney colic on the left side in 1928. In March, 1928, a right nephrolithotomy was performed. At this time pyelographic studies also revealed a large calculus present in the lower and larger half of a double kidney on the left side. There was an incomplete duplication of the ureter on the left side with bifurcation at the middle and upper third of the ureter. Operative removal of the renal calculus was deemed inadvisable because of the marked infection present in both kidneys and the reduced renal function in each kidney. From 1926 to 1933 she recovered about 75 cystoscopic treatments in the form of bilateral ureteral dilatations and pelvic lavages at intervals of 2 to 4 weeks.

For 2 weeks previous to admission the patient had been confined to bed because of marked weakness and severe pain in the left upper quadrant. She also complained of chills, fever, nausea and vomiting. The urine had been very cloudy and at times bloody. The patient complained of frequent every hour during the day, and nocturia 1 to 3 times, burning on urination, urgency, and hematuria. She noticed a swelling of the left upper quadrant for the previous 2 weeks, which gradually increased in size. She was also troubled with abdominal distention, flatulence, eructation, and constipation.

On examination the patient appeared to be acutely ill and very toxic. There were no evidences of shock or collapse. Cardiac findings were those of mitral insufficiency. The lungs were clear. The abdomen was soft, but the left upper quadrant was rigid, and tenderness in the left upper quadrant, left loin, and left lumbar region. The urine gave a strongly positive test for albumin and microscopically showed a large number of pus cells, an occasional red blood cell, granular casts and organisms which proved to be *Bacillus coli*. The leucocyte count was 9,400 and 78 per cent polymorphonuclears. The blood urea was 20 mgm. per cent. Intravenous pyelogram was reported as 10 per cent for the first hour and 15 per cent for the second hour.

A diagnosis was made of an acute exacerbation of a calculus pyonephrosis and symptoms pointed to the presence of an accompanying perinephritic abscess on the left side. Due to the fact that the patient appeared to be critically ill, cystoscopic and pyelographic studies were not carried out. Immediate operation was advised upon admission to the hospital, but the family refused permission to be removed from the hospital. She was given a preoperative transfusion of 500 cc. of citrated blood. Ten days after admission to the hospital an exploratory lumbar incision was made and a large perinephritic abscess was found surrounding the entire kidney and containing about 3 quarts of a thick, greenish pus which on culture was reported as *Bacillus coli*. The abscess extended up to the diaphragm and down to the pelvic brim, but had not broken into the abscess area was emptying sinus. Then a drainage of the abscess area was provided. Due to the poor condition of the patient, it was decided not to explore the kidney or to attempt to remove the kidney. Following the operation, the patient appeared to rally somewhat, but on the third postoperative day became stuporous and semicomatose and died the following morning.

A partial autopsy was performed which disclosed a double kidney on the left side with an incomplete duplication and a partial atrophy was performed which disclosed a semicomatose and died the following morning.

Pyelographic examination revealed dilatation of the left pelvis with an extravasation of dye outside the kidney pelvis. Ninety three days after the previous plastic operation on the pelvis incision and drainage was performed at the site of the old sinus tract and 30 cubic centimeters of a foul smelling sero-sanguinous material escaped. Three days later a left nephrectomy was performed under spinal anesthesia. The patient made an uneventful recovery and was discharged from the hospital with the wound entirely healed.

Examination of the left kidney showed diffuse pyelonephritic involvement of the kidney substance with a diffuse cortical abscess formation also a marked perinephritis was present. At the ureteropelvic junction which was the site of the Heinecke Mikulicz repair there was a very marked narrowing of the mucosa producing almost complete obstruction. There was a perforation in the line of the suture.

The cause of the perirenal extravasation of urine in this case was the failure of the suture line to hold following plastic repair of the stricture at the ureteropelvic junction and the development of a postoperative stricture and subsequent perforation at this point. Obviously, the suture line held for a short time after operation for a pyelographic study performed 35 days after operation showed no extravasation of dye. However, it is possible that the suture line was weakened as a result of the postoperative pyelographic study undertaken to check the result of the operation. Intravenous urography for this purpose should preferably have been employed.

#### TREATMENT

The key note of success in the treatment of rupture or perforation of the kidney pelvis is immediate operative intervention. The type of operative treatment may be either conservative or radical since no hard or fast rules can be laid down to apply to every case. There are several factors which require careful consideration and which may greatly influence the surgeon in his choice of operative therapy. These factors are (1) the early recognition of the true nature of the disease, (2) the general condition of the patient, (3) the time elapsing between the pelvic rupture and the diagnosis of the condition and institution of operative treatment and (4) determination of the pathological condition of affected kidney and condition of the opposite kidney. If the patient has been under observation for some time due to the uncertainty of the diagnosis or to the failure of the physician to recognize the serious nature of the condition, the operative treatment may vary depending upon the secondary pathological complications developing in the course of the disease. The final decision as to the type of operative therapy must be reserved until the time of operation as a very careful and rational pre operative plan

of therapy may be disorganized by the pathological findings encountered at operation, i.e., extent of extravasation of urine and suppuration in the perirenal tissues, and the presence of a severe disease process in the damaged kidney.

The most important step in the surgical treatment of ruptured pelvis is prompt and adequate drainage of the extravasated urine or pus in the perirenal tissues. This procedure is a veritable life saving measure as it assures proper elimination of urine and pus from the perirenal tissues, relieves the patient of toxic absorption of urine, fibrin and tissue ferments, enables the patient to regain strength and recover from shock. All other steps in the operative treatment can be postponed or delayed, if necessary, without jeopardizing the life of the patient.

Occasionally, the immediate institution of the drainage of the perirenal tissues is sufficient to effect a cure. It is conceivable that such a favorable outcome may be obtained in the case of a traumatic rupture of the pelvis of a congenitally normal kidney in which the perirenal extravasation of urine is handled efficiently. In such a case, perirenal suppuration is absent or very slight and clears up entirely and the pelvic fistula closes spontaneously. It is very important that the surgeon should expose the entire kidney, if possible, and make a careful examination of the kidney in order that any additional tears or rupture in the renal parenchyma, pelvis, vascular pedicle and posterior peritoneum are not overlooked or neglected.

The ideal conservative form of treatment combines incision and drainage of the perirenal tissues with repair of the rupture or perforation in the pelvis and correction of the pathological process responsible for the rupture. While this plan of treatment is in keeping with the trend of modern renal surgery toward the conservation of the kidney, it is not always possible or advisable to adhere to this type of treatment. In reality there are relatively few cases of ruptured pelvis that lend themselves to such conservative operative therapy. This procedure was employed in 2 cases (Rowland, Cowden). In the majority of instances, the extravasation of urine has proceeded on to frank suppuration and the kidney shows signs of severe damage, so that any attempt to save the kidney in the presence of a severe suppurative process in the kidney and surrounding tissues may jeopardize the patient's life or prolong the convalescence unnecessarily. However, there is a small percentage of cases in which this type of conservative treatment is recommended and urged. When the patient is operated upon without



complete circular laceration, cicatricial stenosis, or destructive process, the pelvic fistula may persist and a conservative plastic operation on the renal pelvis may suffice to effect a cure. However, it is very likely that even under these favorable circumstances, the destructive process in the affected kidney has impaired the kidney function to such an extent that the improvement in the function of the affected kidney following plastic operation is so slight that infection or stasis soon ensue, necessitating subsequent nephrectomy.

Obviously in those cases in which evidence of bilateral renal disease has been previously determined, preliminary incision and drainage is indicated pending a more complete investigation of both kidneys. This type of treatment was employed in 2 of 3 fatal cases which were moribund at the time of operation. In cases of ruptured pelvis complicated by bilateral renal insufficiency or bilateral hydronephrosis, temporary pyelotomy or nephrostomy or decapsulation at the time of preliminary incision and drainage may be an extremely valuable measure and may preserve the function of the kidney until some final corrective procedure is carried out.

Occasionally the presenting symptoms may be so strongly suggestive of an intra abdominal lesion that an exploratory laparotomy to rule out such a lesion was performed (Dodge, Rowland McAlpine, Hammel) before exposing the kidney through the usual lumbar incision. It is well to point out that infrequently the ruptured pelvis, especially in the spontaneous type, may be accompanied by a peritoneal perforation with peritonitis and it may be advantageous to approach or remove the kidney by the transperitoneal route and at the same time provide drainage of the perirenal tissue through a stab incision in the loin.

The question of anaesthesia is an important one. When preliminary incision and drainage is performed in patients who are critically ill or moribund, the operation should be done under local infiltration anaesthesia. If the patient's general condition is good and symptoms of shock or toxæmia are absent, spinal anaesthesia, using 50 to 100 milligrams novocain may be employed with safety as in 2 of the author's cases. Inhalation narcosis with ether, whose cardiac stimulative powers are well known, should be employed in those cases presenting threatening signs of vascular collapse or showing a low cardiac reserve.

#### CONCLUSIONS

A review of 64 cases of ruptured pelvis collected from the literature and the author's expe-

rience with 3 personal cases warrants the following conclusions:

1 Rupture of the kidney pelvis proper is a relatively rare condition. The rupture may be of the traumatic or spontaneous (non traumatic) type.

2 The traumatic type of ruptured pelvis may occur in a congenitally normal kidney or in an acquired inflammatory (chronic pyelonephritic) or obstructive (hydronephrotic) kidney. The rupture is usually the result of direct or indirect trauma exerted against the kidney in such a manner that the physiologically or pathologically distended or chronically inflamed pelvis is jammed against the lower ribs or the transverse processes of the upper lumbar vertebrae as maintained by Kuster. The rupture is usually linear and radial in character. The degree of external violence varies from a crushing injury to an indirect blow in cases of rupture of a hydronephrotic pelvis.

3 The spontaneous type of pelvic rupture practically always occurs in a kidney which is the seat of a chronic pyelonephritic process or whose pelvis is dilated as the result of a ureteral or pelvic obstruction. The most common type of spontaneous rupture is the rupture of the pelvis of a hydronephrotic kidney secondary to an obstruction of the ureter or pelvis by a calculus or stricture. The rupture occurs as the result of a sudden or gradual alteration in the increased back pressure caused by an obstructive lesion in the upper or lower urinary tract. Perforation of the pelvis resulting from pressure necrosis of an impacted calculus is another frequent type of spontaneous rupture.

4 Rupture of a pathologically weakened pelvis may also occur as the result of instrumental perforation or follow the exertion of increased pressure in the syringe method of pyelography. In rare instances, perforation may be due to chemical necrosis following the injection of a strong alkali by mistake during pyelography or renal lavage.

5 The traumatic type of rupture has a greater incidence than the spontaneous type. The traumatic type apparently occurs with greater frequency among the males which may be due to the fact that males are subjected to greater hazards in this age of highly mechanical industries, automotive travel, and competitive sports. The spontaneous type occurs with about equal frequency in both sexes. The traumatic type may have a greater incidence in children due to increased susceptibility of a pathologically weakened pelvis in children to rupture following mild trauma which may be attributed to the persistence of

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- 3 CROFT, J. A case of traumatic hydropnephrosis. *Tr Soc Soc*, Lond, 1881, 14, 107—one case
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- 5 MORRIS, H. On the symptoms and treatment of contusions of the kidney. *Chin J*, Lond, 1884, 4, 217—one case
- 6 JACARRET, A. Case of subcutaneous rupture of the kidney. *Quoted by Kappeler*—one case
- 7 SNOW, H. *Quoted by Kappeler*—one case
- 8 DODGE, C. L. Subcutaneous rupture of the kidney with a report of nine cases. *Ann Surg*, 1902, 36, 899—909—one case
- 9 ROWLAND, R. P. Case of ruptured ureter due to trivial injury. *Med Press Circ*, Lond, 1909, 87, 404—one case
- 10 WITTEBOZ, H. Traumatische Hydropnephrose gebildet durch Pyelonecrose. *Zischr f Urol*, 1911, 5, 672—677—one case
- 11 MARRIN, W. Rupture of the ureter followed by extravasation of urine and suppurative nephritis, necrosis. *Ann Surg*, 1912, 55, 468—one case
- 12 BERTANNO, A. Two cases of ruptured hydropnephrosis. *Zischr f Urol*, 1912, 6, 713—two cases
- 13 BARRY, H. Injuries to the kidney and ureter. *Brit J Surg*, 1913, 11, 609—four cases
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- 15 NASH, W. G. Traumatic laceration of a hydro-nephrosis. *Lancet*, 1924, 1, 128—one case
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- 20 OSOON, A. T., and CAMPBELL, M. F. Injuries of the kidney. *Practice of Surgery*, edited by Dean Lewis, Vol 8, Chap 5. Hagerstown, Md W F. Prior Co., 1928—1930—two cases
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- 22 MATHIE, C. P. Spontaneous rupture of kidney. *Tr Western Branch Soc. Am Urol Ass*, 1931, 1, 78, Urol Soc, Lond, 1926, 5, 214—one case
- 23 LEZAROV, J. A. Traumatic rupture of a congenital hydronephrosis. *Ann Surg*, 1932, 95, 117—one case
- 24 EVELL, G. H. Traumatic rupture of a hydronephrotic kidney. *J Urol*, 1933, 29, 687—one case
- 25 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 26 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 27 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 28 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
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- 84 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 85 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 86 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 87 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 88 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 89 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 90 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 91 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 92 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 93 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 94 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 95 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 96 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 97 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 98 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 99 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases
- 100 LEVY, F. Pyelographic rupture of the kidney pelvis—26 cases

1 LAWRENCE, C. Case of aqueous encysted tumor of the kidney. *Med Chir Tr*, 1833, 18, 175—one case

The cases in the first five groups are arranged in chronological order

infantile ptosis and lack of bony protection of the ribs

6 There is no definite symptom complex or clinical syndrome that is absolutely typical or constantly associated with rupture of the pelvis. The urologist should suspect a rupture of the pelvis if patient gives an antecedent history of chronic pyelonephritis or hydronephrosis secondary to calculus in the pelvis or ureter and presents the following train of symptoms, viz, sudden sharp pain in renal region followed by sudden or gradual swelling or mass in same area, accompanied by chill, fever, nausea, vomiting, and frequently shock or collapse. Signs of collapse may be present in the traumatic type of rupture but absent in the spontaneous

7 The clinical impression of ruptured pelvis should always be confirmed or substantiated by a thorough urological study including pyelography since this is the only dependable method of diagnosis. The advantages of the gravity method of pyelography and Wesson's combined method of intra-venous urography and ureteral catheterization and the dangers of syringe pressure pyelography cannot be too strongly emphasized. In the extremely toxic and debilitated patients, retrograde pyelography is contra indicated but intra-venous pyelography can be substituted without fear of producing any unpleasant symptoms or complications

8 Successful treatment in cases of ruptured pelvis is directly dependent upon an early diagnosis and immediate surgical intervention. The ultimate choice of the operative procedure can only be made at time of operation and must take in consideration the general condition of the patient, pathological condition of the kidney as seen at operation, and the extent of the extravasation of urine or the suppurative process in the perirenal space

9 Treatment may either be conservative or radical. The conservative procedure is essentially incision and drainage and, if possible, correction of pathological processes responsible for the rupture and repair of the pelvic laceration. The radical procedure is nephrectomy provided the opposite kidney is healthy. In the very toxic and debilitated patients treatment should be carried out in two stages, viz, preliminary incision and drainage followed by nephrectomy or conservative repair at a later date

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## FRACTURES OF THE HUMERUS END-RESULTS FROM TREATMENT

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THE following review of end results from treatment of fractures of the humerus covers a 5 year period from January 1, 1926, to December 31, 1930. All cases of fracture of the humerus encountered at the Mayo Clinic during this period are reviewed here. For the purpose of tabulation, we have divided these cases into 8 groups.

Our classification does not conform to the one usually given. In most classifications supracondylar fractures are all grouped with "fractures of the elbow" and in many of such classifications fractures of the neck and head of the humerus are grouped with fractures of the shoulder. We have not attempted to divide supracondylar fractures into the usual groups but have separated fractures of the single condyles, epicondyles, and the capitellum as well as those of the trochlea. This grouping conforms to anatomical types and presents interesting comparative features, particularly in regard to the incidence of late nerve complications associated with injuries about the elbow.

The predominance of old fractures of the shaft will be seen in Table I. This, of course, is a fracture that is seen frequently, but at the same time it must be realized that it is a difficult fracture to treat and one that leads to many unsatisfactory results. This predominance is partly accounted for by the frequent injury of the musculospiral nerve, a complication that in many cases leads to a major complaint, and the frequency with which non union is also encountered combines with injury of the musculospiral nerve to make up the majority of cases in this group of old fractures of the humerus.

In Table II we have listed the cases of old fracture of the shaft of the humerus according to the main complaint on admission, that is the chief reason why patients sought further medical advice and treatment. Non union makes up the largest of these groups, and because of the frequency with which it is encountered in fractures of the humerus it would be expected to be the most frequent complaint. Taking the cases of non union alone, and adding to them the cases of non union with nerve injury and non union with

infection, we have a total of 58 cases, or about 6, per cent of the entire group. This group contains a few cases that should be classed as delayed union. We have considered all cases that were seen more than 2 weeks after the time of injury as old fractures. There are, therefore, a few cases that should be classed not as delayed union or non union but simply as cases of recent fracture with malposition.

Some few patients were given reassurance that their arms would be all right, and this satisfied them. There were 2 pathological fractures in the group, one resulting from a bone cyst and the other almost certainly from parathyroid hyperfunction with osteitis fibrosa cystica. One case was a medicolegal problem only, the patient coming with her lawyer rather than with her physician.

This group of cases represents, of course, a great many failures of treatment elsewhere. From the study it is hard to account for all of these failures, many, perhaps, were due to poor reduction, some, to infection, and so forth. It seems to us, however, that probably the most common cause of failure was too short a period of fixation or inadequate fixation. The humerus is probably the most difficult bone in the body to fix adequately and securely, and it is apparent from the study that this is a common cause of failure in its treatment.

Besides the original surgical treatment in the cases set forth in Table III, in many cases there had been operations for non union. In all, 44 patients had had surgical operations prior to their admission to the clinic. Several of these patients had had multiple operations performed, as many as 4 in some instances. In all, 78 operations had been performed in these 44 cases, or an average of 1.8 operations per patient.

The problem presented, in these cases, therefore, varied considerably. The non union group presented the most important problem from the standpoint of the orthopedic surgeon.

In the majority of cases listed in Table II, treatment consisted of massive bone graft, as described by Henderson. Very little modification in this technique has taken place since that time.

TABLE I—FRACTURES OF HUMERUS 1926-1930

OLD

Cases	Original treatment (elsewhere)		Total	
	Closed	Open	Closed	Open
35	35	15	50	1
36	36	4	40	1
37	37	3	40	1
38	38	1	39	1
39	39	1	40	1
40	40	1	41	1
41	41	1	42	1
42	42	1	43	1
43	43	1	44	1
44	44	1	45	1
45	45	1	46	1
46	46	1	47	1
47	47	1	48	1
48	48	1	49	1
49	49	1	50	1
50	50	1	51	1
51	51	1	52	1
52	52	1	53	1
53	53	1	54	1
54	54	1	55	1
55	55	1	56	1
56	56	1	57	1
57	57	1	58	1
58	58	1	59	1
59	59	1	60	1
60	60	1	61	1
61	61	1	62	1
62	62	1	63	1
63	63	1	64	1
64	64	1	65	1
65	65	1	66	1
66	66	1	67	1
67	67	1	68	1
68	68	1	69	1
69	69	1	70	1
70	70	1	71	1
71	71	1	72	1
72	72	1	73	1
73	73	1	74	1
74	74	1	75	1
75	75	1	76	1
76	76	1	77	1
77	77	1	78	1
78	78	1	79	1
79	79	1	80	1
80	80	1	81	1
81	81	1	82	1
82	82	1	83	1
83	83	1	84	1
84	84	1	85	1
85	85	1	86	1
86	86	1	87	1
87	87	1	88	1
88	88	1	89	1
89	89	1	90	1
90	90	1	91	1
91	91	1	92	1
92	92	1	93	1
93	93	1	94	1
94	94	1	95	1
95	95	1	96	1
96	96	1	97	1
97	97	1	98	1
98	98	1	99	1
99	99	1	100	1

TABLE IV—FRACTURES OF HUMERUS SHAF

Cases	Original treatment (elsewhere)		Total	
	Closed	Open	Closed	Open
35	35	15	50	1
36	36	4	40	1
37	37	3	40	1
38	38	1	39	1
39	39	1	40	1
40	40	1	41	1
41	41	1	42	1
42	42	1	43	1
43	43	1	44	1
44	44	1	45	1
45	45	1	46	1
46	46	1	47	1
47	47	1	48	1
48	48	1	49	1
49	49	1	50	1
50	50	1	51	1
51	51	1	52	1
52	52	1	53	1
53	53	1	54	1
54	54	1	55	1
55	55	1	56	1
56	56	1	57	1
57	57	1	58	1
58	58	1	59	1
59	59	1	60	1
60	60	1	61	1
61	61	1	62	1
62	62	1	63	1
63	63	1	64	1
64	64	1	65	1
65	65	1	66	1
66	66	1	67	1
67	67	1	68	1
68	68	1	69	1
69	69	1	70	1
70	70	1	71	1
71	71	1	72	1
72	72	1	73	1
73	73	1	74	1
74	74	1	75	1
75	75	1	76	1
76	76	1	77	1
77	77	1	78	1
78	78	1	79	1
79	79	1	80	1
80	80	1	81	1
81	81	1	82	1
82	82	1	83	1
83	83	1	84	1
84	84	1	85	1
85	85	1	86	1
86	86	1	87	1
87	87	1	88	1
88	88	1	89	1
89	89	1	90	1
90	90	1	91	1
91	91	1	92	1
92	92	1	93	1
93	93	1	94	1
94	94	1	95	1
95	95	1	96	1
96	96	1	97	1
97	97	1	98	1
98	98	1	99	1
99	99	1	100	1

to change from a plaster of paris cast to an aeroplane splint at the end of 8 weeks. However, as a rule it is much safer to continue with the plaster cast until the end of 3 months at least. Rehabilitation should be carried out only after one is certain that union has taken place. Massage and active exercises should be the modes of reestablishing movement of the affected part.

In cases where infection was the predominant cause of complication, treatment was carried out according to the stage of the infection, and, when sequestra were present, they were removed surgically. In general a modified Orr treatment was used for osteomyelitis (Table V), that is, thorough surgical preparation of the wound, using vaseline gauze packs as dressings. These were usually changed once a week to prevent the odor from becoming too offensive.

The cases summarized in Table VI present nerve complications as the most important physical finding and make up a large group, they will be dealt with more fully in another paper. This table is inserted here to complete this statistical study.

As we have stated before, all fractures under 2 weeks' duration have been considered new fractures. In the group in Table VII there were 35 of these fractures over the 5 year period, and the

TABLE II—FRACTURES OF HUMERUS SHAF

Cases	Original treatment (elsewhere)		Total	
	Closed	Open	Closed	Open
35	35	15	50	1
36	36	4	40	1
37	37	3	40	1
38	38	1	39	1
39	39	1	40	1
40	40	1	41	1
41	41	1	42	1
42	42	1	43	1
43	43	1	44	1
44	44	1	45	1
45	45	1	46	1
46	46	1	47	1
47	47	1	48	1
48	48	1	49	1
49	49	1	50	1
50	50	1	51	1
51	51	1	52	1
52	52	1	53	1
53	53	1	54	1
54	54	1	55	1
55	55	1	56	1
56	56	1	57	1
57	57	1	58	1
58	58	1	59	1
59	59	1	60	1
60	60	1	61	1
61	61	1	62	1
62	62	1	63	1
63	63	1	64	1
64	64	1	65	1
65	65	1	66	1
66	66	1	67	1
67	67	1	68	1
68	68	1	69	1
69	69	1	70	1
70	70	1	71	1
71	71	1	72	1
72	72	1	73	1
73	73	1	74	1
74	74	1	75	1
75	75	1	76	1
76	76	1	77	1
77	77	1	78	1
78	78	1	79	1
79	79	1	80	1
80	80	1	81	1
81	81	1	82	1
82	82	1	83	1
83	83	1	84	1
84	84	1	85	1
85	85	1	86	1
86	86	1	87	1
87	87	1	88	1
88	88	1	89	1
89	89	1	90	1
90	90	1	91	1
91	91	1	92	1
92	92	1	93	1
93	93	1	94	1
94	94	1	95	1
95	95	1	96	1
96	96	1	97	1
97	97	1	98	1
98	98	1	99	1
99	99	1	100	1

In several instances, where sequestra were present or where there was any sort of infection, it was necessary to do one or two preliminary operations to prepare the bone for the graft. The removal of foreign fixative substances, such as bone plates or Farman bands, may be done at the same time that the bone graft is applied, provided no infection is present. When infection is present, it should be cleared up and should be quiescent for a period of 6 months to 2 years before a bone graft operation is undertaken.

Care must be exercised to get the ends of the ununited bone to fit together as accurately as possible. One must also drill the eburnated ends, so that a sufficient opening is made into the marrow cavity to allow new circulation to be established through the eburnated bone. The graft is fitted as accurately as possible to the surface of the bone and held with a clamp until beef bone screws can be inserted to hold it in place. A plaster of paris body cast, with the arm in 45 degrees abduction, is applied. Much operative time can be saved by applying the body portion of the cast prior to operation.

At the end of 3 weeks the wound should be dressed and the sutures removed. The period of fixation with the plaster after this varies considerably. In most instances union will be firm enough at the end of 3 months to allow removal of the cast and the use of a sling. However, one must be guided by examination of the part, both by roentgenogram and by physical examination. Too long a fixation period is far better than one that is too short. In a few cases it may be safe

to change from a plaster of paris cast to an aeroplane splint at the end of 8 weeks. However, as a rule it is much safer to continue with the plaster cast until the end of 3 months at least. Rehabilitation should be carried out only after one is certain that union has taken place. Massage and active exercises should be the modes of reestablishing movement of the affected part.

In cases where infection was the predominant cause of complication, treatment was carried out according to the stage of the infection, and, when sequestra were present, they were removed surgically. In general a modified Orr treatment was used for osteomyelitis (Table V), that is, thorough surgical preparation of the wound, using vaseline gauze packs as dressings. These were usually changed once a week to prevent the odor from becoming too offensive.

The cases summarized in Table VI present nerve complications as the most important physical finding and make up a large group, they will be dealt with more fully in another paper. This table is inserted here to complete this statistical study.

As we have stated before, all fractures under 2 weeks' duration have been considered new fractures. In the group in Table VII there were 35 of these fractures over the 5 year period, and the

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TABLE V—FRACTURES OF HUMERUS SHAFT  
OLD (89 CASES)—MISCELLANEOUS TYPES

	Cases treated at clinic	Results			
		Good	Fair	Poor	Unknown
Sequestrectomy	7	3		2	2
Spint	4	1		2	1
Physiotherapy	4	1	1		2
Open reduction with bone screws	3	1		1	1
Removal of foreign body or sequestra	3	1	1	1	
Pathological no treatment	2			1	1
Beef bone plate	1	1			
Cast	1	1			
Total	25	9	2	7	7

No orthopedic treatment given 22 cases. Refused advice only compensation satisfactory etc. (Neurological cases included)

TABLE VI—FRACTURES OF HUMERUS SHAFT  
OLD (89 CASES) COMPLICATING NERVE LESIONS\*

	Cases treated at clinic	Results			
		Complete recovery	Partial recovery	No recovery	Unknown
Non surgical treatment	19	6	2	8	3
Surgical treatment					
Explored no suture	2			2	
Explored neurolysis	4	2			2
Explored sutured	5	3		1	1
Brachial plexus avulsion	5			4	1
Median nerve	1			1	
Ulnar nerve sutured	1				1
Total	37	11	2	16	8

Musculospiral primary 22 cases secondary 8 cases

way these were treated and the results obtained are indicated in the table<sup>1</sup>

In the consideration of the treatment of acute fracture of the shaft of the humerus, several facts are of importance in coming to a conclusion as to the type of treatment best suited to the case. Simple transverse fractures are best held by some

\*We have used the terms good, fair, poor, and unknown. As good results were classed all the 5 cases in which firm bony union without deformity and with practically no limitation of motion was obtained. Under fair results were classed the cases in which firm bony union followed but with some deformity or limitation of motion. Under poor results were classed the cases in which union was not obtained or in which there was some impairment of function or deformity sufficient to make the patient seriously handicapped by the result. Unknown results apply to those cases which we were unable to trace. It should be noted also that in many cases where no treatment was recommended here, particularly in the case of old fractures without any prospect of improvement, no follow up was attempted.

TABLE VII—FRACTURES OF HUMERUS SHAFT  
NEW (35 CASES)

	Cases treated at clinic	Results		
		Good	Fair	Unknown
Open (11 cases)				
No internal fixation	4	1	2	1
Beef bone plate	3	3		
Beef bone screw	2	2		
Beef bone screw and Parham band	1	1		
Lane plate	1	1		
Closed (24 cases)				
Cast	8	6		2
Aeroplane splint	7	6		1
Velpeau bandage	4	3		1
Not treated	3	1		
Bed traction	1	1		
Both humeri	1	1		
Total	35	26	2	5

\*Two died

form of internal fixation, either a bone plate or a beef bone screw. In many cases it is extremely difficult to get enough engagement of the fragments without internal fixation to hold the fracture either in a cast or in an aeroplane splint. Oblique or spiral fractures are more easily held in most instances, but excellent position may be obtained by the use of some form of internal fixation, either a beef bone screw or a Parham band.

As will be seen in the table, in most cases treatment consisted of either a cast or an aeroplane splint with traction. Often when a cast was used, some type of traction was also used, making a fixed traction type of support. When traction is used, it should always be checked carefully with the roentgenogram, to prevent the fragments from being pulled apart. Communited fractures of the humerus must always be considered most favorable for such treatment because of the difficulty in getting sufficient fixation by any form of internal fixation.

In the 2 cases in which the patients died, there were severe multiple injuries, and fractures of the humeri were merely incidental to the cause of death. Fractures treated with Velpeau bandages were green stick fractures without enough separation to require any additional fixation. "Bed traction" is shown as having been used in only 1 case. As a matter of fact, it was used in a considerable number of cases preliminary to casts or

TABLE IV—FRACTURES OF HUMERUS NECK AND HEAD NEW (57 CASES) (SURGICAL NECK, 38 CASES)

Results	Cases treated at clinic				Surgical neck sample (28 cases)	Acroplane splint	Open beef bone screw	Cast	Bandage	Surgical neck comminuted (4 cases)	Acroplane splint	Open no fixation	Surgical neck comminuted with dislocation of head (4 cases)	Acroplane splint	Open, no fixation	Surgical neck impacted (2 cases)	Total
	Good	Fair	Poor	Unknown													
	14	8	2	1	3	1	2	1	3	1	1	1	1	2	2	2	38

TABLE VIII—FRACTURES OF HUMERUS NECK AND HEAD OLD (39 CASES)\*

Results	Cases treated at clinic				Physiotherapy	Open beef bone screw	Excision head	Removal wire	Manipulated	Greater tuberosity (6 cases)	Physiotherapy	Manipulation	Acroplane splint	No treatment	Epiphyseal separation	Open beef bone screw	Osteomyelitis	Sequestrectomy	Total
	Good	Fair	Poor	Unknown															
	11	6	2	3	2	4	3	1	1	1	2	2	2	1	1	1	3	31	39

movements. Fractures treated by open reduction ones in which reduction could be accomplished The 2 cases in which excision of the humeral head was done were old fractures of the neck with dislocation of the head. These are without doubt the most unsatisfactory cases of all for successful treatment. Excision of the head of the humerus does not give a good result. It does, as a rule, however, relieve pain, and it may relieve pressure on the nerves in the axilla, thus preventing or minimizing the secondary nerve changes that often take place.

A group of 6 cases of fracture of the greater tuberosity are included in this table. Unless marked displacement takes place in these fractures, no special attempt at reduction is necessary. Some advocate abduction of the arm by the use of an acroplane splint to prevent displacement of the fragments by the pull of the supraspinatus and infraspinatus tendons. Unfortunately, in this particular group we were able to follow only 2 cases in both of which there had been attempts to improve the movement in the shoulder by manipulation. This is a procedure of value in some cases, but we must emphasize the fact that

in the more severe injuries it is a necessity. In fractures of the humerus with some over-riding or deformity, bed traction will be found very useful in reducing the deformity and improving the position. In cases of severe swelling in which rest is needed, it is a practical method of obtaining correction of the position and absolute rest in bed at the same time. One case of fracture of both humeri is listed. These are difficult cases in which to secure proper fixation. The use of the acroplane splint is difficult and often times impossible. A double cast is the most satisfactory fixation, provided one gets accurate replacement. We feel that in these cases, where conditions permit, internal fixation of at least one bone will give the best results. Bed traction cannot be continued in these cases for over a few days at a time.

In many ways the cases listed in Table VIII are the most difficult types in which to obtain satisfactory results. Old stiff shoulders, especially those with dislocation or deformity, offer about as unfruitful a field for obtaining successful results as anyone can imagine. However, in many instances marked improvement can be obtained with persistent and skillfully applied physiotherapy, particularly with active and passive

TABLE X—FRACTURES OF HUMERUS NECK AND HEAD NEW (57 CASES)

	Cases treated at clinic	Results			
		Good	Fair	Poor	Un known
Anatomical neck (13 cases)					
Aeroplane splint	4	3	1		
Open no fixation	3			2	1
Open beef bone screw	2	1	1		
Bandage	4	2	1		1
Greater tuberosity (4 cases)					
Aeroplane splint	1	1			
Open beef bone screw	1	1			
Cast (dislocation)	1	1			
Slings	1				1
Lesser tuberosity					
Slings	1	1			
Pathological (giant cell tumor)					
Curettement and bone graft	1	1			
Total	19	11	3	2	3

it must be used with a great deal of care in the treatment of old fractures, because of the danger of pathological fracture when atrophy through disuse is marked

In the group in Table X we again return to the more acute fractures and we have tabulated the fractures of the surgical neck. As will be seen in this table the most frequently used type of treatment was the aeroplane splint. In these cases a splint without traction should be used. It should be carefully fixed with adequate support to hold it up into the axilla. At the clinic, we make each splint to fit the individual patient. When much malposition or displacement is present manipulation under anaesthesia is the routine before application of the splint. Where satisfactory reposition of the fragment cannot be obtained, we feel that open operation is indicated, and the most useful form of internal fixation has been the beef bone screw. In some cases no internal fixation is necessary. Good alignment can thus be obtained and the results have well justified the means. No poor results were obtained in any of the fractures treated by open reduction. In estimating these results we have only listed as good results those with union without deformity and with practically a normal range of motion. Those with fair results included the cases in which union was obtained but in which normal motion

TABLE XI—FRACTURES OF HUMERUS (SUPRA CONDYLAR) OLD (38 CASES)

	Cases treated at clinic	Results			
		Good	Fair	Poor	Un known
Deformity (12 cases)					
Physiotherapy	6	1	1	1	3
No treatment	2		1		1
Open reduction	1	1			
Advised operation (n.t. done)	1				1
Arthroplasty	1			1	
Transplant ulnar nerve	1	1			
Limited motion (14 cases)					
Arthroplasty	3			2	1
Physiotherapy	3	2			1
No treatment	6			2	4
Capsulotomy	1		1		
Manipulation	1			1	
Limited motion and infection					
Drainage	2	1			1
Myositis ossificans	1	no treatment			
Osteochondritis dissecans					
Removal of loose bodies	1	1			
Total	30	7	3	7	12

was not recovered, although in most of these there was sufficient motion to allow use of the shoulder

It will be noted in Table X that in these cases open reduction did not produce as good results as in fracture of the surgical neck. Usually fracture of the anatomical neck presents a much more difficult problem because of the small size of the proximal fragment. When severe displacement occurs, however, it is often impossible to obtain satisfactory reduction by manipulation and open methods must be resorted to. These types are usually more serious and are doomed to a very unsatisfactory result if left alone.

Strangely enough the 4 fractures of the greater tuberosity were each treated in a different manner. All the results were satisfactory where final reports were available, which goes to show that any method of treatment that is carried out carefully may produce good results in this type of fracture.

One fracture of the lesser tuberosity and one pathological fracture in a case of giant cell tumor of the head of the humerus are included in the list and need no comment.

TABLE VII—FRACTURES OF HUMERUS (SUPRA-CONDYLAR) NEW (38 CASES)\*

Results	Cases treated at clinic		Total	* Cases not treated here
	Good	Fair		
With displacement (29 cases)	17	24	2	1
Manipulation acute lesion	5	2	3	2
Open belt bone screw	7	2	3	2
Open calque fixation	1	2	3	2
Without displacement (4 cases)	2	2	2	2
Cast	1	1	1	1
Sling	1	1	1	1
Acute fixation	1	1	1	1
Total	33	32	8	3

TABLE VI—FRACTURES OF HUMERUS (SUPRA-CONDYLAR) OLD (38 CASES)

Results	Cases treated at clinic		Total
	Fair	Poor	
Volkman's ischaemic paralysis (8 cases)	1	1	1
Splint and physiotherapy	4	2	1
Tendon plastic	2	2	1
Osteotomy	1	1	1
No treatment	1	1	1
Total	8	4	2

The group of cases in Table VI represents a type of fracture in many ways as difficult to treat as old fractures of the head and neck of the humerus. In fact, this type may be regarded as worse because it is with these fractures that Volkman's ischaemic paralysis occurs and in many of the cases there are complicating injuries of the ulnar nerve in addition. No special form of treatment seems to be applicable, and each case is a problem in itself.

We have divided the cases according to those in which the chief complaint was of deformity and those in which it was of limited motion. Arthroplasty in these cases does not offer a great deal, if we are to judge by the results obtained in this group. It should not be entirely condemned, however, as we have seen occasional good results from its use. Attempts to correct the deformity, except in fairly recent cases, usually meet with unsatisfactory results. Again, skillfully handled physiotherapy is the most useful method of treatment. We do not feel that manipulation in these cases offers much. We have occasionally seen cases where numerous manipulations have been carried on over a period of several weeks' convalescence. Usually the results are not good. The group of cases of Volkman's paralysis presented in Table XII is fairly representative of severity of the deformity and paralysis. The end results in this group of new supra-condylar fractures (Table XIII) emphasize the fact that adequate early treatment may prevent many poor results. We have 3 essential things to consider in this group (1) the reduction of the

The need for adequate early reduction and proper fixation is recognized by all. When there is marked swelling, however, as a rule something must be done to relieve it. Elevation of the arm may be used, but it is a slow method and, for this reason, somewhat dangerous. We have aspirated haematoma of large size as a means of reducing the swelling. The other alternative is open reduction, which of course evacuates the blood clot and relieves tension, so that much of the danger of ischaemia is averted. In difficult cases with marked swelling, we feel that it is the choice method of treatment, provided facilities are at hand for carrying out careful bone surgery. The choice position of fixation in these cases is not without danger, as has already been indicated. If swelling is great, fixation to an acute angle may further embarrass the circulation. A position must be employed in which the radial pulse can be felt. Furthermore, any type of constricting dressing must either be watched carefully or else not used. If adhesive strips are used to hold the angle of fixation, they must be placed so as to avoid pressure on the musculospiral nerve. In

TABLE XIV—FRACTURES OF CONDYLE AND CAPITELLUM NEW (22 CASES)

	Cases treated at clinic	Results		
		Good	Fair	Un known
Capitellum (6 cases)				
Open removal fragment	2	1	1	
Open beef bone screw	1	1		
Open fragments sutured	1	1		
Slung	1	1		
Radial condyle (8 cases)				
Acute flexion	2	2		
Open suture	2	1	1	
Slung	2	2		
Physiotherapy	2	1		1
Ulnar condyle (3 ca. es)				
Excision	2	2		
Slung	1	1		
Ulnar epicondyle (4 cases)				
Acute flexion	2	2		
Open beef bone screws	1			1
Slung	1	1		
Radial epicondyle (1 case)				
Acute flexion	1	1		
Total	22	18	2	2

many cases a moulded posterior, plaster of paris splint is the safest sort of dressing

Early motion is desirable. But unless early motion can be supervised by the surgeon himself, or by an expert physiotherapist, disappointing results may ensue. In children, under proper conditions motion may be begun at the end of 1 week, provided perfect reduction has been accomplished. However, it is safer to wait from 10 days to 2 weeks before starting such movement in most cases.

One must not be distressed at slow recovery of movement. Children are often very slow to push their activities to the point of pain. Patience and time will in most instances produce excellent results. Impatience resulting in manipulations under anaesthesia may produce a persistently painful elbow without any improvement in motion.

This group of fractures (Table XIV) has been classed separately because, for the most part, they make up an entirely distinct group. By distinct is meant that they should be distinguished from the usual supracondylar fracture. We found in

TABLE XV—FRACTURES OF CONDYLE AND CAPITELLUM OLD (22 CASES)

	Cases treated at clinic	Results			
		Good	Fair	Poor	Un known
Radial condyle (12 cases)					
No treatment	4	1			3
Physiotherapy	4		1	2	1
Ulnar nerve transplant	1			1	
Advised nerve transplant	1		1		
Removal of wire	1		1		
Ulnar condyle (8 cases)					
No treatment	3				3
Physiotherapy	2				1
Ulnar nerve transplant	2		1		1
Volkman paralysis (tendon pla. tie)	1	1			
Radial epicondyle (1 case)					
Ulnar nerve transplant	1	1			
Ulnar epicondyle (1 case)					
No treatment	1				1
Capitellum (1 case)					
Advised operation (refused)	1				1
Total	22	3	4	3	12

reviewing our cases that in many the diagnosis was not accurate when filed, and only by reviewing the roentgenograms were we able to make the correct diagnosis. Fractures of one or the other condyle are almost certain to lead to trouble if not accurately reduced. Two complications must be looked for: (1) an almost certain bony deformity, either cubitus valgus or varus, depending on whether the internal or the external condyle is displaced, (2) tardy ulnar palsy. Of 8 cases of late paralysis of the ulnar nerve in 4 there were fractures of the radial condyle, in 3 of the ulnar condyle, and in 1 the diagnosis was intercondylar fracture. Accurate replacement of these fragments then, is of the utmost importance and in case of inability to get them back into position by closed reduction one should not hesitate to perform open reduction. When no displacement is present, and this is often the case, the problem is simply one of proper fixation. When severe comminution of either condyle or capitellum takes place the best treatment is removal of the bone fragments.

The group of old cases in Table XV presents an unsatisfactory group from the standpoint of treatment. The reasons are obvious. Severe de-



Clinic These comprise all types, new and old, Each group is discussed briefly The old fractures of the shaft offer the most interesting group among the 22 cases either no treatment or physiotherapy was advised in 14 shows how little could be offered from the standpoint of reconstructive surgery

#### SUMMARY

We have reviewed 341 cases of fracture of the humerus seen over a 5 year period at the Mayo

#### REFERENCES

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## ACUTE MECHANICAL INTESTINAL OBSTRUCTION MORTALITY WITH AND WITHOUT ENTEROSTOMIES

BASED ON A REVIEW OF 241 CASES FROM THE RECORDS OF THE COOK COUNTY HOSPITAL  
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**D**URING the past 15 years the literature has been filled with accounts of the value of enterostomies advising their performance when in the least doubt of an obstruction, and claiming marvelous results. These claims have not been made with any qualifying statement that the quoted results can be obtained in certain skillful hands, but have been broadcast in such a manner as to lead one to believe that any individual can make an enterostomy in any particular portion of the small bowel with little or no danger to the patient, and with a great certainty as to the ultimate favorable outcome, in other words, that enterostomy is a definite and distinct life saving procedure. Its advocates have apparently forgotten the struggles of Nicholas Senn, Jacob Frank, John B. Murphy, and others, to overcome the great morbidity associated with enterostomy a procedure which had been in use for several centuries, by perfecting a means of end-to-end or lateral anastomosis.

Many writers recommend the making of enterostomies but do not mention any attempt whatever to relieve the obstruction. The accompanying case histories from Cook County Hospital which have been studied with great care show the mortality of an acute intestinal obstruction in relation to enterostomies of any kind as well as the mortality of resections. They also show the great value of an early exploratory operation when there is any doubt concerning an acute intestinal obstruction whether it be complete or incomplete.

The mass of experimental work that has been done upon intestinal obstruction has so many different angles that it would be impossible to attempt to discuss adequately every phase of that problem in this article. We can, however, say with certainty that most of it has been fruitless and serves only to confuse us in our efforts to lessen mortality unless an early operation is performed and, if possible, the obstruction is also removed.

We have reviewed 241 cases from the records of the Cook County Hospital. From this mass of material we have attempted to extract a few facts that will be helpful in handling this serious surgical emergency without attempting to discuss

every controversial point which would lead us away from clinical cases to an involved discussion of the theories and experimental work.

The case records reviewed cover all cases filed under the head of "Acute Mechanical Intestinal Obstruction" during the years from 1912 to 1931. This does not include strangulated external hernias or chronic obstructions, which are filed separately and which present a somewhat different problem. For the purposes of statistical study, only those cases operated upon are included. Cases of obstruction secondary to carcinoma or intra abdominal abscess are not included because of complications peculiar to this type of case. A few of these cases were not completely obstructed, but all were of the acute type which constitutes a surgical emergency.

### ETIOLOGY

For the sake of brevity we shall discuss under etiology only the type of case reviewed. A more complete discussion of the whole subject would properly include adynamic ileus, ileus due to peritonitis, mesenteric thrombosis, and cases mentioned in the preceding paragraph.

The relation of age and sex to the occurrence of acute mechanical intestinal obstruction is shown in Table I. The condition is quite evenly divided between the sexes. After the age of intussusception it decreases in childhood and is evenly distributed throughout adult life. Except that intussusception occurs in infancy, usually below the age of 2, age is of little value in diagnosis.

Adhesions, forming bands or kinks, and foramina through which the bowel may herniate are the most common causes of mechanical intestinal obstruction (Table I). They account for 74 per cent of the cases in this series. It is important to note that 34 or 19 per cent, of these cases due to adhesions had no previous surgery. Cases due to postoperative adhesions were most common following surgical procedures for intra abdominal infection. There were included in the pelvic operations, however, 13 hysterectomies which were not associated with known pelvic infection. The miscellaneous operations include gunshot wounds and various operations too infrequent to classify separately.

TABLE 1.—SEX AND AGE INCIDENCE AND ETIOLOGY

Sex	Age	Infants (under 2 yrs)	Infancy (2 to 15)	III Etiology	IV Etiology	Age	Sex
Male	170	14	14	1	1	1	1
Female	170	10	10	2	2	2	2
Infants (not noted)	170	10	10	3	3	3	3
170	170	10	10	4	4	4	4
170	170	10	10	5	5	5	5
170	170	10	10	6	6	6	6
170	170	10	10	7	7	7	7
170	170	10	10	8	8	8	8
170	170	10	10	9	9	9	9
170	170	10	10	10	10	10	10
170	170	10	10	11	11	11	11
170	170	10	10	12	12	12	12
170	170	10	10	13	13	13	13
170	170	10	10	14	14	14	14
170	170	10	10	15	15	15	15
170	170	10	10	16	16	16	16
170	170	10	10	17	17	17	17
170	170	10	10	18	18	18	18
170	170	10	10	19	19	19	19
170	170	10	10	20	20	20	20
170	170	10	10	21	21	21	21
170	170	10	10	22	22	22	22
170	170	10	10	23	23	23	23
170	170	10	10	24	24	24	24
170	170	10	10	25	25	25	25
170	170	10	10	26	26	26	26
170	170	10	10	27	27	27	27
170	170	10	10	28	28	28	28
170	170	10	10	29	29	29	29
170	170	10	10	30	30	30	30
170	170	10	10	31	31	31	31
170	170	10	10	32	32	32	32
170	170	10	10	33	33	33	33
170	170	10	10	34	34	34	34
170	170	10	10	35	35	35	35
170	170	10	10	36	36	36	36
170	170	10	10	37	37	37	37
170	170	10	10	38	38	38	38
170	170	10	10	39	39	39	39
170	170	10	10	40	40	40	40
170	170	10	10	41	41	41	41
170	170	10	10	42	42	42	42
170	170	10	10	43	43	43	43
170	170	10	10	44	44	44	44
170	170	10	10	45	45	45	45
170	170	10	10	46	46	46	46
170	170	10	10	47	47	47	47
170	170	10	10	48	48	48	48
170	170	10	10	49	49	49	49
170	170	10	10	50	50	50	50
170	170	10	10	51	51	51	51
170	170	10	10	52	52	52	52
170	170	10	10	53	53	53	53
170	170	10	10	54	54	54	54
170	170	10	10	55	55	55	55
170	170	10	10	56	56	56	56
170	170	10	10	57	57	57	57
170	170	10	10	58	58	58	58
170	170	10	10	59	59	59	59
170	170	10	10	60	60	60	60
170	170	10	10	61	61	61	61
170	170	10	10	62	62	62	62
170	170	10	10	63	63	63	63
170	170	10	10	64	64	64	64
170	170	10	10	65	65	65	65
170	170	10	10	66	66	66	66
170	170	10	10	67	67	67	67
170	170	10	10	68	68	68	68
170	170	10	10	69	69	69	69
170	170	10	10	70	70	70	70
170	170	10	10	71	71	71	71
170	170	10	10	72	72	72	72
170	170	10	10	73	73	73	73
170	170	10	10	74	74	74	74
170	170	10	10	75	75	75	75
170	170	10	10	76	76	76	76
170	170	10	10	77	77	77	77
170	170	10	10	78	78	78	78
170	170	10	10	79	79	79	79
170	170	10	10	80	80	80	80
170	170	10	10	81	81	81	81
170	170	10	10	82	82	82	82
170	170	10	10	83	83	83	83
170	170	10	10	84	84	84	84
170	170	10	10	85	85	85	85
170	170	10	10	86	86	86	86
170	170	10	10	87	87	87	87
170	170	10	10	88	88	88	88
170	170	10	10	89	89	89	89
170	170	10	10	90	90	90	90
170	170	10	10	91	91	91	91
170	170	10	10	92	92	92	92
170	170	10	10	93	93	93	93
170	170	10	10	94	94	94	94
170	170	10	10	95	95	95	95
170	170	10	10	96	96	96	96
170	170	10	10	97	97	97	97
170	170	10	10	98	98	98	98
170	170	10	10	99	99	99	99
170	170	10	10	100	100	100	100

In the 34 cases due to adhesions not associated with previous surgery, the cases was not determined in 32. In the 11 remaining cases in which the cause was determined, the frequency and variety of inflammatory insults that are the common cause of adhesions are clearly demonstrated. Intussusception is the next most common cause of mechanical obstruction, (21 in this series—87 per cent). The majority occur in infancy below the age of 2. In the 4 occurring in later years, 2 were due to benign tumors, and in 2 no cause was found (Table I).

Internal hernias occurred in 5 per cent of the cases in this series. These are cases not produced by adhesions and the cause of these foramina can not be definitely stated. The most probable explanation is that they were of congenital origin (Table I).

Volvulus occurred in 37 per cent of the cases. Many of the cases of volvulus are really due to adhesions and where the etiologic factor seemed solely the result of adhesions, they were classified under that heading. True volvulus not associated with adhesions or previous operative procedures is rare and in this series constituted only 7 per cent of the cases (Table I).

Macek's diverticulum causes obstruction due to either the formation of adhesions around an intussusception or invagination and intussusception as a cause of intestinal obstruction. In this series of cases. Other rare causes are shown in Table I.

That acute mechanical obstruction can be produced by a variety of causes must be kept in mind when making a diagnosis. The fact that no known etiological factor is apparent from the history and examination of the patient should not be confusing when the other symptoms and physical findings are present.

The cardinal symptoms of intestinal obstruction were pain, nausea vomiting, and constipation.

Pain was usually the first symptom complained of. It was invariably present. Its character is of diagnostic importance. The early pain was struggled to force its contents past the obstruction. It was intermittent, occurring at intervals which varied somewhat with the type, complete or partial, and duration of the obstruction. Auscultation will show peristalsis in many cases to be most active at the height of the pain. This type of peristaltic pain is important diagnostically as it is

and prostration increased and peristalsis decreased, the pain became more generalized and in many cases was less severe.

Nausea and vomiting occurred at, or a short time after, the onset of the obstruction, the interval depending on the completeness and location of the obstruction. Vomiting increased in frequency as the obstruction became more severe. The character of the vomitus changed and became foul—slowly, if obstruction was incomplete, rapidly, if it was complete.

Obstipation was as constant as pain and vomiting but often more confusing in its interpretation and determination. A patient may be constipated before the actual onset of obstruction or the obstruction be so fulminating that the lack of a bowel movement since onset is not abnormal. The determination of obstipation by the use of the enema is a subject about which there is some current controversy. In this series of cases enemas gave valuable information. The results of enemas as an aid in diagnosis may, however, be misleading unless interpreted properly.

Wangensteen has shown in dogs that a bowel may evacuate itself below a complete obstruction after an enema and has observed the same phenomenon in clinical material. One of us operated for an obstruction 2 hours after gas and faeces were obtained by an enema, and found a gangrenous bowel. We have also observed that a bowel may evacuate itself early due to the initial insult of a developing obstruction and thereafter very little if any gas will form distal to the obstruction. It must be remembered that it is probably impossible to tell the exact time when a partial obstruction becomes complete, and that there may be results from an enema in case of a partial obstruction that may rapidly progress to completeness. Enemas were given in 97 cases classified as nearly as possible by the operative findings as complete obstruction. In 80 cases, or 83 per cent the enema was returned clear or slightly colored, usually 'poor results' was the notation used in the chart. In 11 cases, or 12 per cent, good or fair results were obtained, but in only 2 of these cases was a second enema given which gave a return of faeces and gas. In 7 cases classified under 'poor or no results,' the first enema gave a return of faecal material and gas, and the second no results. Results of enemas given were noted in 17 cases classified as partial obstruction. Good results were noted in 10 cases, or 58.8 per cent, and poor results in 7 cases, or 41.2 per cent. When the diagnosis is in doubt, a second enema should be given. The records of the enemas did not in every case indicate the results

completely and accurately. Much better information will be obtained if the surgeon is present when the enema is given, rather than relying on the observation of the nurse. It is evident from these statistics that the results of enemas must be properly interpreted if they are to be of value in making a diagnosis of mechanical obstruction. Peristalsis should be present, indicating that the bowel is attempting to empty itself and that diffuse peritonitis is absent. If faeces and gas are obtained and the symptoms of distention, pain, and vomiting are not relieved, one may be certain that the obstruction continues and surgery is indicated. Results after an enema are not a contra indication to surgery unless the patient is relieved and in many cases symptoms will recur requiring surgery. If faeces and gas are obtained from the first enema, further enemas will usually be returned without gas or faeces if the obstruction is complete or approaching completeness.

#### PHYSICAL FINDINGS

Intestinal obstruction was not associated with a constant rise in temperature in this series of cases. In those cases without gangrene, 44 per cent were from 97 degrees to 98.6 degrees, 27 per cent were elevated less than 1 degree, 25 per cent elevated from 1 to 2 degrees, and 3 per cent elevated over 2 degrees. Less than 1 per cent were under 97 degrees. Rather surprising was the fact that those cases with gangrene showed practically the same temperature changes. While temperatures over 100 degrees are not the usual finding, a small number of cases had a temperature of from 101 to 103 degrees. These temperatures were only slightly more frequent in those cases with gangrene. A rise in temperature of over 101 degrees occurred in a few cases without gangrene or marked damage to the bowel wall. These may probably be explained on the basis of dehydration.

There was no correlation between the temperature and leucocyte count. The mouth temperature, if taken when the patient is dehydrated and mucous membranes are dry, may give readings lower than the true temperature taken in the rectum. There was a rather constant increase in pulse rate which seemed to have a definite relation to the toxicity of the patient. The respiratory rate increased with the development of distention.

Distention varied with the duration and completeness of the obstruction. Some complete obstructions with gangrene had little distention when high in the intestinal tract or of short duration. Some partial obstructions demanding surgery had no distention.

TABLE II—PRESENCE OR ABSENCE OF PERISTALSIS OBSERVED IN 177 CASES

Cases Per cent	Without gangrene			With gangrene		
	1 Increased	2 Present or normal	3 Decreased	4 Absent	5 Absent	6 Normal
100	89	10	1	18	5	2
79	91	120	32	92	2	2
21	89	10	1	18	5	2

Tenderness to palpation was present more often than one would assume from the writings on intestinal obstruction in surgical textbooks. Of 214 cases, it was noted as present in 167 and absent in 47. There was no typical distribution of tenderness. In many cases it was present throughout the abdomen. In those cases where a mass was palpable, tenderness was most often localized or most marked in the region of the mass.

Rigidity was noted in 41 cases, 20 of which were complicated by the presence of gangrene. The terms "tenderness," and "rigidity," as noted by different examiners, may be somewhat confusing, but at any rate they seemed to have been more common than generally expected. We should like to be able to state the degree of damage to the bowel in those cases in which rigidity was noted and actual gangrene was not present, but this is difficult to do from records made by a number of observers.

The most important abdominal finding is increased peristaltic activity. Table II shows the occurrence of peristalsis. In determining the presence of peristalsis, auscultation is the most valuable method. Visible peristalsis was noted in only a few cases. Audible evidence of peristalsis was infrequent and was occasionally missed at first, during a cursory examination, only to be noted at a second examination. In a few high observations it was heard only in the epigastrium. In a few cases it was heard in one side of the abdomen and not in the other.

In this series there were 32 cases in which absence of or decreased peristaltic sounds were noted on physical examination and at operation no gangrene or peritonitis was found. Eighteen of these patients died, a mortality of 56 per cent. Comparing this with a mortality of 28.5 per cent for the entire number of obstructions without gangrene, we are impressed with the importance of diminished or absent peristaltic sounds as an indication of bowel injury, even in the absence of actual gangrene.

In Table II, the data on absence of peristaltic sounds in gangrene of the bowel are shown. In a few of these cases peristaltic sounds apparently continued a short time after the occurrence of strangulation gangrene. However, in most cases the advent of gangrene stopped the audible peristalsis after a short interval. In other cases with marked distention, peristaltic sounds had ceased some time before the occurrence of gangrene.

LABORATORY EXAMINATIONS

Our observations regarding blood counts are not entirely in accord with statements in current literature. In Table II, the data on absence of peristaltic sounds in gangrene of the bowel are shown. In a few of these cases peristaltic sounds apparently continued a short time after the occurrence of strangulation gangrene. However, in most cases the advent of gangrene stopped the audible peristalsis after a short interval. In other cases with marked distention, peristaltic sounds had ceased some time before the occurrence of gangrene.

The mortality of acute mechanical intestinal obstruction has not changed in the past 30 years. The mortality rate in series of cases by operators in other large hospitals ranges from 23.5 per cent to 60.9 per cent. No attempt is made to compare these rates, for the series would vary as to types of cases included. There have been series of cases reported by single operators with mortality rates as low as 16 per cent. Research regarding the cause of death has added little of value in reducing fatalities.

We are startled to observe that the statistics in Table III do not indicate a higher mortality due to delay knowing as we do the positive danger of delay in the given case. Statistics notwithstanding, delay in operation is not excusable. Every case of partial or complete obstruction carries with it the possibility of a damage to the blood supply of the bowel that cannot be determined before operation. In some of the cases obstruction was partial for a variable length of time before becoming complete or producing gangrene, it is difficult or impossible to select the case with which one may safely temporize. Table III also indicates the frequency with which the deaths, in the cases of obstruction that were operated on early, are due to strangulation of a loop. It is obviously difficult to draw conclusions as to the increase of mortality due to delay in surgery when this type of case is included in the cases of short duration. If we omit the cases of gangrene and obstruction in infancy we have a mortality of 13.7 per cent for cases of acute obstruction without gangrene operated on in the first 48 hours. There were 46 cases in which delay in surgery occurred because of a diagnosis of partial obstruction. Some of these were cases of several days' duration at entrance with a history of mild symptoms, presumably they were partial and delay was perhaps justified by that assumption. In other cases, partial obstruction was diagnosed and interference was delayed because results were obtained by an enema, or because there was little distention or the patient had a bowel movement after admission. Seventeen of these 46 patients died—a mortality of 36.9 per cent. In only 4 was there a gangrenous bowel found at operation. The mortality is higher than for all those cases without gangrene (28.5 per cent). In these cases complete obstruction was not diagnosed even on entrance to the hospital and in many cases was not present at operation, apparently the longer duration producing severe damage to the bowel, was the factor responsible for the high mortality.

Mortality increases in proportion to duration of symptoms in cases of intussusception in infancy. There were 16 cases with 8 deaths. In 10 the duration was less than 48 hours and there were 3 deaths among these. Of 6 cases with a longer duration than 48 hours, only 1 recovered. Obviously, intussusception diagnosed and operated upon early should carry a low mortality.

Table IV gives interesting data regarding the use of drainage of the bowel and enterostomy. In these cases draining the bowel at operation and closing the opening apparently did not accomplish the results hoped for. Table IV shows an

TABLE III—MORTALITY ACCORDING TO DURATION

	Cases	Deaths	Mortality per cent
24 hours or less	10	2	20
25 to 48 hours	35	10	28
49 to 72 hours	33	11	33
73 to 96 hours	41	16	39
97 to 120 hours	31	13	42
121 to 144 hours	14	9	64
145 hours and over (including partial obstruction)	58	28	48
Not noted	7	5	71

Summary of deaths in cases with a duration of 48 hours or less.

Gangrene by strangulation of loop	0
Intussusception in infancy	3
Congenital occlusion of ileum	1
Notes incomplete	2
Adhesions without gangrene	1
Bowel accidentally torn	1

increased mortality for the procedure, which does not seem entirely accounted for by the fact that the cases in which it was used were more serious than those in which the bowel was not opened. A comparison will show that the mortality equals that for resection of a gangrenous loop.

#### ENTEROSTOMY

In the few cases of obstruction in which enterostomy was done and the obstruction was relieved as well, the mortality again was as high as that for resection and anastomosis for gangrene. It was noted in some of these cases that enterostomy had not drained the partially paralyzed bowel effectively, and that distention had continued. In this series of cases enterostomy has not reduced mortality, contrary to the claims of some writers. Enterostomy without relief of the obstruction was done in 8 cases of this series with 8 deaths. From these statistics it would seem that enterostomy does not preclude rupture of a gangrenous loop nor does it restore its viability, and apparently it does not prevent the development of gangrene if the obstruction is not surgically relieved.

The results of the treatment of gangrenous bowel also are shown in Table IV. The cases in which gun barrel fistula was done may have been more serious than those in which resection and anastomosis was the procedure used. Admittedly it is difficult to draw conclusions from a series of cases done by different operators but the mortality of exteriorization or gun barrel fistula is so high in this series that resection and anastomosis seems the procedure of choice except in a very few cases. Gun barrel fistula in this series of cases has not reduced mortality.

Factors in the high mortality of gun barrel fistula were (1) infection of the abdominal wound and peritoneum, (2) digestion of abdominal wall (3) secondary operations necessary for closure.



The measures which failed to emphasize or have allowed one to forget these needs have not produced results

## CONCLUSIONS

1 Enterostomy, drainage of the bowel, and gun barrel fistula have not reduced mortality in this series of cases, as a matter of fact, those treated by these procedures show a very high mortality. We believe that a fistula, while it does have merits in certain cases, must be justified by careful consideration of the entire case before it is performed. Otherwise, it may increase instead of decrease the chances of death.

2 Simple obstruction without actual gangrene, when delay has resulted in marked distention and absence of peristalsis gives physical findings and mortality similar to that of gangrene due to strangulation.

3 The classification of obstruction into the strangulation type with gangrene and simple obstruction is difficult clinically, and dangerous if it leads to delay in surgery.

4 Distinction between partial obstruction and complete obstruction is also difficult to make and delay in operating for partial obstruction leads to marked increase in mortality.

5 Many cases of obstruction occur from causes not apparent from the patient's history and physical findings.

6 We believe that an adequate enterostomy proximal to the resection of an obstructed and injured area will prove to be of great value.

7 Clinical study and autopsy findings show that mechanical damage to the intestine from distention and strangulation causing gangrene and peritonitis or peritonitis before the development of actual gangrene, is the usual primary cause of death in acute mechanical intestinal obstruction. However in addition to these pathological changes one must never lose sight of the marked dehydration which is uniformly present in all cases of obstruction in our opinion, the restoration of the body fluids with isotonic salt solutions, when administered by intravenous and subcutaneous methods is a life saving procedure.

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## SPONTANEOUS RUPTURE OF THE COMMON BILE DUCT

## A SEQUEL OF CHOLEDOCHOSTOMY

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**R**UPTURE of the common bile duct is an unusual accident. Either it is caused by trauma or it is spontaneous in origin, the trauma being the usual cause.

It has become increasingly frequent to interrogate the common bile duct by the direct method of incision and probing to obtain accurate information from within the channel, rather than to rely entirely upon an appraising eye or a palpating finger examining the outside layer and wall of the main biliary tube. Owing probably to the more numerous searches and intubations of the duct, we have had occasion to deal with 3 instances of duct rupture in the past 4 years. They have all followed choledochostomy. Our experience with the first case enabled us to make a pre-operative diagnosis in the 2 other cases.

The cases are reported in some detail because they depict a distinct clinical entity which may be recognized. We also offer a few suggestions that may help to prevent this grave complication.

## REPORT OF CASES

**CASE 1.** J. F., aged 55 years, white female, had frequent attacks of gall stone colic beginning 35 years ago. A gall bladder with calculi was removed 25 years ago. Following the operation the pain recurred as before. During a very severe seizure of biliary colic associated with jaundice, the patient was admitted to the hospital and operated on (June 3, 1933). A choledochostomy was performed, a number of calculi in the common duct were removed, and a T tube was inserted. The postoperative course was uneventful; the jaundice cleared rapidly and the tube was removed on the twenty-fourth day after operation (June 27, 1933).

The patient was home and well for 10 days when she had an attack of cramp-like pains in the abdomen radiating slightly to the right of the interscapular region associated with epigastric distress, belching, and rectal tenesmus but without vomiting. This attack lasted for 3 hours. Following this episode there was another seizure several days later which was more severe and of longer duration. This was accompanied by marked abdominal distention and regurgitation. The stools were large and foul smelling. One week following this second attack the woman again suffered from excruciating cramp-like pains in the epigastrium radiating to the right side and associated with nausea and vomiting. She was then immediately readmitted to the hospital (July 28, 1933).

**Physical examination on admission.** The patient was acutely ill, prostrated, icteric, with a marked malar flush. The tongue was dry, the abdomen rigid. There was a sense of fullness in the right side of the abdomen with exquisite tenderness at the level of the umbilicus on that side. No fluid wave or shifting dullness was demonstrable. White blood count 10,000 leucocytes per cubic millimeter of blood with 18 per cent polymorphonuclears. The urine showed albumin graded 3 plus, red blood cells and granular casts.

Temperature was 103 degrees F. The pulse rate was 100 per minute. Respirations were 12 per minute. An operation with spinal anesthesia disclosed an abdominal cavity filled with foul smelling, bloody, biliary fluid which contained shreds of necrotic tissue. After the fluid was aspirated a rupture of the common bile duct was visualized. Intraductal calculi were felt, but the condition of the patient precluded any attempt to remove them at the time. Three Penrose drains were inserted into the subhepatic area. The postoperative course was uneventful until August 14 when the patient had another attack of pain. A few months later she was operated upon again for relief of common duct obstruction and the calculi felt at the previous operation were removed. This time a drainage T tube was left in situ for 7 months.

It is of interest that this patient was operated upon 2 years later for a perforating juxtapyloric ulcer for which a gastrectomy was performed. No ulcer was present at any of the previous operations.

**CASE 2.** R. B., aged 26 years, white female, gave a history of numerous attacks of biliary colic of 4 months duration. During the last of these attacks she developed jaundice. On May 9, 1933, the operative notes revealed that the gall bladder was chronically inflamed, but non-calculous. The common bile duct was dilated and contained a cast of thick mucoid material. A cholecystectomy was performed followed by a choledochostomy, a straight rubber catheter being used for drainage. The postoperative course was uneventful and the tube was removed on the eleventh post-operative day. The external wound was closed by June 7. Four days later the patient experienced a sudden attack of pain in the abdomen and back and vomited undigested food. There was no constipation. Following this seizure she was readmitted to the hospital.

**Physical examination.** There was disclosed a healed upper right rectus scar and a rigid abdominal wall which was tender throughout. There was impaired resonance with distant breath sounds at both lung bases. Tenderness was definite in the left costovertebral angle. Icterus was noted. The temperature was 102 degrees F. The pulse rate was 108 per minute. Respirations were 22 per minute. White blood count 16,000 leucocytes with 68 per cent polymorphonuclear cells. The urine showed a faint trace of albumin and bile. The blood chemistry was normal. A diagnosis of acute pancreatitis was made and expectant treatment was advised. A roentgenographic study revealed that both diaphragmatic cusps were obliterated by some subdiaphragmatic condition. The temperature mounted to 104 and 105 degrees F. The diagnosis was changed to that of spontaneous rupture of the common bile duct. The abdominal cavity was opened, a local anesthetic being used and was found to be filled with bile and pus. When the fluid was suctioned off a rupture in the common bile duct was disclosed. Three cigarette drains were placed in the region of the duct and in Morrison's fossa. The postoperative temperature rose to 107 and 108 degrees F. The patient was given transfusions, stimulants and parenteral fluids but despite these measures, she died the next day. The culture of the peritoneal fluid showed *Bacillus coli*. No necropsy was obtained.

**CASE 3.** P. C., aged 42 years, white female, had suffered from biliary colic for 1 year. At times the accompanying

that a spontaneous rupture of the common bile duct may follow cholecystostomies, an immediate abdominal operation will be performed instead of instituting any expectant treatment.

The etiology of the spontaneous rupture of the common bile duct is probably a subacute infectious process at the site of the cholecystostomy.

With the drainage tube *in situ*, this process is adequately protected. However, when the tube is removed and the common bile duct begins to heal, the granulations are soft and friable, and undue strain on the wall of the duct at this point, because of increased pressure, may cause a rupture. Once the bile escapes into the peritoneal cavity, a widespread peritonitis may develop. That bile causes such a reaction has been proved by many investigators. There is also the possibility that many of the localized subhepatic pools that follow common duct intubations have resulted from a rupture of the duct, the collection being walled off from the general peritoneal cavity.

To prevent such a sequel to cholecystostomy, we advocate that the T-tube or rubber catheter, when removed, be replaced by a straight rubber tube of the same diameter into the original sinus. That effective removal of all infectious material may be maintained until the duct is given adequate opportunity to repair solidly the damage done by the trauma of the operation and the pathological process.

#### SUMMARY

- 1 Three cases of spontaneous rupture of the common bile duct are reported following cholecystostomy.
- 2 The diagnosis may be made before operation by the recognition of this definite clinical entity.
- 3 Immediate operation under local anesthesia is indicated.
- 4 The etiology of this complication of cholecystostomy is discussed.
- 5 A means of prevention is suggested.

During an operation on June 19, 1933, a small contracted gall bladder was visualized. The common bile duct was markedly dilated and contained calculi. A cholecystostomy was performed with a drainage T tube. The gall bladder was undisturbed. The postoperative course was uneventful except for a low febrile trend during the first 11 days. The tube was removed 2 weeks postoperatively, and the wound healed. She was re-admitted on August 31, 1933, with a day history of pain in the upper abdomen associated with fever and jaundice.

*Physical examination on admission.* The patient was acutely ill, with the right upper quadrant of the abdomen tender and rigid, a healed scar in this area, a mild icterus, and moderate abdominal distention. The temperature was 100 degrees F. The pulse rate was 106 per minute. Respirations were 20 per minute. A diagnosis of spontaneous rupture of the common bile duct was made, and an operation was immediately performed under a local anesthetic. When the peritoneum was opened, a large amount of blackish brown bile fluid was disclosed. This was suctioned off. The patient's condition contraindicated any further surgical manipulation. Three cigarette drains and a gauze drain were inserted. The patient had a stormy postoperative course for the first 3 days, and then made a rapid and complete recovery.

A careful review of the literature has failed to reveal reports of similar cases, but they may be from a critical study of these cases, one is impressed by certain striking and definite characteristics. In brief, the syndrome may be reconstructed in this fashion. A patient with a long history of biliary colic, who may or may not have had a previous cholecystectomy, enters the hospital with definite evidence of common bile duct obstruction. The obstruction is relieved, the proof of patency of the duct is established, a cholecystostomy is performed, and the patient recovers satisfactorily. After a time, the tube is removed, and the draining sinus finally closes. Suddenly, the patient is seized with upper abdominal pains, vomits, becomes distended, is icteric, has a coppery-red malar flush, is icteric, and prostrated. Rigidity and tenderness develop in the upper abdomen. Leucocytosis and polynucleosis are present. The abdominal cavity is re-opened, and is found to contain a tremendous amount of admixed biliary fluid.

Acute pancreatitis as the condition most likely to be confused with this syndrome. If it is realized

## EDITORIALS

### SURGERY, GYNECOLOGY AND OBSTETRICS

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MARCH, 1935

### CONGENITAL CYSTS AND FISTULÆ OF THE NECK

THE study of congenital cysts and fistulæ of the neck is of great interest from an embryological standpoint, a knowledge of their development affords the surgeon not only an exact map for the field of action but also an understanding of the many intricate, fascinating, and rapid transformations of organic anlagen so that he is better able to cope with such tumors. In the main congenital cysts and fistulæ of the neck are divided into two groups: median and lateral.

The median cysts and fistulæ have been recognized as having the course of the anlage of the thyroid which was discovered by His who found that in its course through the tongue this tract was always a solid cord, never a tube with a lumen. At times high columnar, and again pavement cell epithelium was found in the persistent thyroglossal duct and for the most part there were several parallel ducts with much lymphoid tissue around them and clusters of acinous glands. This did not conform with a thyroid tissue origin. Were these larger ducts formed by such acinous

glandular material? The epithelium is of such different appearance that this origin can be readily excluded. In early stages of the thyroid anlage we see a comparatively large lingual duct, the channel which leads from the foramen cæcum into the tongue and from the bottom of which the thyroid anlage develops. This lingual duct is not only relatively large but it has in addition branches which run in part parallel to the main channel. Even in the normal adult the channel leading from the foramen cæcum varies considerably in length. It is rather probable therefore that the thyroglossal duct is an abnormally long and persistent lingual duct. It has been argued that thyroglossal duct fistulæ never have an opening into the foramen cæcum. This is not correct, however. It is true that a probe inserted into the fistulous tract is arrested chiefly at the hyoid bone, but this is due to a linking or to a local obliteration which very often occurs at this point. The hyoid receives cartilaginous form in the beginning of the fifth week of embryonal life when the normal thyroglossal tract has vanished. If a "duct" persists at that time, the hyoid may develop behind it, which is the most frequent happening, or it may include the channel, or in rare cases may develop in front of the duct. Very frequently the duct is linked off or entirely obliterated at this point. However, in some cases the whole channel could be injected. Takeda could inject the fistula even from the foramen cæcum and found that the injected fluid appeared in drops from the outer fistulous opening. The lymphoid tissue and the clusters of mucous glands accompanying the duct lumina can be

This view of the third pharyngeal pouch. The great mass of lymphoid tissue at the base of the tongue, called lingual tonsil, reaches anteriorly to the foramen caecum. A thyroglossal duct which is still present in later life is probably the result of an abnormally long and persistent lingual duct which was drawn downward in the fourth week of embryonal life by the very rapid descent of the thyrioid anlage. In the majority of the cases, fistulae are caused in postnatal life by perforation of a pre-existing cyst. An adenoma or a carcinoma may develop from an embryonal inclusion such as described and for this reason it will be worth while to study and make note of the exact site of the earliest beginning of a carcinoma of the base of the tongue, some of them have been found to have originated at the foramen caecum.

The lateral congenital fistulae are not as readily and as definitely understood as to origin as are the median ones. In the lateral fistulae several embryonal structures are possible sources.

The second branchial cleft and pouch were thought to have a part in the formation of lateral fistula. This assumption was based on Kahl's demonstration at this location of a very long and narrow channel-like formation (Kahl's duct). The assumption that lateral fistula originated exclusively from the second gill cleft was not accepted by other students of embryology. They believed that the other clefts, not the second alone, might be the cause of such cysts and fistulae. Then, in 1912, Wengjowski, after a thorough study of a large amount of material, published a report in which he concluded that the thyropharyngeal duct, because of the persistence and elongation of the primary thymus anlage which contains a vesicle, was the sole structure responsible for the production of lateral cysts and fistulae. The thymus is a derivative of the production of lateral

This view prevailed for a long time and undoubtedly in many cases, perhaps even in the great majority, the condition was brought about by such factors. This viewpoint did not remain unchallenged, however, for in 1927 Nylander published an account of his embryological research which led him to contradict Wengjowski's views inasmuch as he did not believe Kahl's decision was applicable in all cases. Nylander claimed that even the majority of the lateral cysts and fistulae were due to a persistence of Kahl's duct. The surgeon can decide promptly in a given case whether he is dealing with one or the other variety of fistula, this is possible through his knowledge of the relation of the channel to the carotid vessels. In early embryonal life the external carotid runs straight upward from the common carotid, both vessels lying in front and mesial to the branchial apparatus. The internal carotid is the axis of the third branchial arch which it traverses from in front backward. Any evagination from the second pharyngeal pouch traverses therefore the space between the internal and external carotids, the internal carotid lying posterior, the external anterior to the fistulous tract. If the fistula involved is of the thyropharyngeal duct type, the tract must lead around the outer side of both carotids because the thymus originates from the pouch underneath the third arch. Future exact observations will have to be made to determine the relative frequency of the two origins mentioned. At present the question is still *sub judice*.

In a field in which rapid transformations take place as in the branchial apparatus with its derivatives, many diverse embryonal inclusions are very possible, indeed, several rare isolated cases of fistulae or cysts from other sources are described in the literature.

Embryonal epithelial remnants, according to Cohnheim's theory are a source of neoplasms,

explained as having been drawn along from the surface. The great mass of lymphoid tissue at the base of the tongue, called lingual tonsil, reaches anteriorly to the foramen caecum. A thyroglossal duct which is still present in later life is probably the result of an abnormally long and persistent lingual duct which was drawn downward in the fourth week of embryonal life by the very rapid descent of the thyrioid anlage. In the majority of the cases, fistulae are caused in postnatal life by perforation of a pre-existing cyst. An adenoma or a carcinoma may develop from an embryonal inclusion such as described and for this reason it will be worth while to study and make note of the exact site of the earliest beginning of a carcinoma of the base of the tongue, some of them have been found to have originated at the foramen caecum.

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and in the branchial apparatus may give rise particularly to adenoma and carcinoma. A branchiogenous carcinoma of the neck near the bifurcation of the common carotid is not very infrequent. As in cases of carcinoma of the base of the tongue it will be of interest to investigate, wherever possible, the exact location of the first appearance of the carcinomata of the tonsillar lodge. They are not so very rare and some of them may be due to a remnant of the lateral structures mentioned.

ARNOLD SCHWYZER

## SURGICAL SHOCK

THE modern tendency in surgery is to classify all forms of acute circulatory failure complicating operations and wounds, except organic heart failure under the head of "shock." The causes may be grouped under three general heads, namely, disturbances in vascular tone, disturbances in blood volume and disturbances of tissues and tissue fluids. The importance of the first two has long been known but that of the last has come to light only in more recent years.

Disturbances in vascular tone are brought about mainly through the nervous system. There is much uncertainty as to the role which they play in the production of surgical shock. Pure psychogenic disturbances may produce marked lowering of blood pressure as seen in ordinary syncope which shows many of the features of the shock syndrome. The systolic blood pressure may drop to as low as 50 or 60 millimeters mercury and slight bradycardia develop with resulting unconsciousness, but the reaction is, as a rule, of short duration. If a severe wound resulting in pain and loss of blood, is accompanied by such a psychic reaction, it greatly increases the likelihood of the development of a prolonged state of circulatory depression and may lead to shock. Af-

ferent impulses resulting from nerve stimulation from wounds and operations have long been held to precipitate shock independent of psychic action by directly influencing the vasomotor centers with consequent lowering of blood pressure. The mode of action has been variously interpreted as an exhaustion of the medullary vasoconstrictor center, reflex inhibition of the vasoconstrictor center, or stimulation of the medullary vasodilator center, and there is as yet no unanimity of opinion.

Neurogenic fall of blood pressure is most definitely seen in connection with operations on the abdomen especially on the stomach and gall bladder in which it occurs in approximately 10 per cent of the cases. The anæsthetic may be either local or general. The blood pressure falls during the early part of the operation and in the absence of hæmorrhage. The various pathways of the causative afferent impulses that have been considered are the vagi, the splanchnics, the upper lumbar sympathetics, and the intercostoabdominal nerve roots. The reaction has been most frequently attributed to the vagus, but there are important objections to this theory, especially since it is impossible to reproduce the condition by all types of stimulation of vagus fibers beneath the diaphragm. There is an accompanying mild bradycardia but the respirations show little change. The reaction passes off as the intra abdominal operation is completed and has usually disappeared by the time the abdomen is sutured. Ordinarily it does no damage to the patient and unless blood pressure readings are taken the anæsthetist and the surgeon may be unaware of its intensity. If the operation is prolonged and complicated by other shock producing occurrences, as hæmorrhage, it may assist in leading to a marked state of shock. Ephedrine usually causes its prompt disappearance and should be given if the reaction is prolonged.

Recent studies have shown that loss of plasma as by experimental plasmapheresis results in reduction of circulating blood volume, concentration, and stagnation of erythrocytes and a gradual fall in blood pressure with accompanying manifestations of shock. Blalock showed that sufficient plasma may be lost from manipulation of the intestines of dogs to create shock, but such an occurrence is rarely a complication of operations on man. Alterations of the tissues and tissue fluids as a result of local injury or constriction of the circulation may lead to a state of secondary shock. The cause has been considered by some to be a toxin formed in the damaged tissues which enters the blood stream and produces general toxic symptoms. The toxic agent was thought to be histamine or a histamine-like substance in the case of both wounds and limb constriction. Recent experimental investigations have failed to show the presence of a toxic substance in the damaged tissues or circulating in the blood following either trauma or limb constriction. This does not exclude the possibility of the existence of traumatic toxemia. However, these investigations have also shown that as a result of extensive wounds there is escape of plasma or blood, or a combination of the two, into the tissues in quantities sufficient to create a state of shock. In some cases the blood vessels may be torn and hemorrhage may be the main cause of circulatory failure. If the limb is traumatized without tearing vessels, the main cause is extravasation of plasma with a resultant blood concentration. The fluid produced during the swelling in traumatized limbs has been found to contain as much as 5 per cent of plasma proteins. Prolonged limb constriction results in increased permeability of capillaries and following release, the part swells markedly from the escape of plasma into the damaged tissues. This dislocation of plasma

There is much uncertainty as to whether or not stimulation of the large nerve trunks in other parts of the body ever causes a marked fall in blood pressure when psychic influences are eliminated. Cutting and pinching nerves at operation and electrical tetanization of nerves in experimental animals results in a rise rather than a fall of blood pressure. However, in cases of extreme injury and prolonged and extensive cutting operations where a number of blood pressure lowering factors may be active, it is often impossible to exclude afferent sensory impulses as a contributing agent. Hypertactivity of the sympathetic adrenal system resulting in prolonged arterial spasm has been considered as one of the causes of shock, and the recent work of Cannon and Freeman supports this view. The eventual effect of the vasoconstriction is to damage the capillaries, increase their permeability, concentrate the blood, and reduce the circulating blood volume. More clinical evidence is needed for acceptance of the view that this is an important cause of surgical shock. Loss of blood is, of course, the most important cause of acute circulatory failure and its significance is too well known to warrant discussion here. Suffice it to say that failure to recognize the extent of internal and even external hemorrhage often leads to the erroneous assumption that other factors are responsible for the state of shock. Loss of blood and psychogenic and neurogenic reactions are the three conditions that may bring about rapid fall in blood pressure with the accompanying picture of shock. However, a patient with a tumor of the adrenal medulla (theochromocytoma) may be thrown into a critical state of high blood pressure and rapid pulse presumably from hyperadrenalinaemia by an operation or injury (as a fracture of the hip recently observed) with a fall in blood pressure before the death.

proteins may result in impairment of circulation and shock that proves fatal before signs of gangrene have had time to develop. Burns and freezing have been demonstrated to produce circulatory failure in the same way. Plasma proteins are gradually poured out into the damaged tissues in such quantities that marked blood concentration and reduction in circulating blood volume are brought about, explaining the state of shock which may develop without the assumption of the formation of toxic substances.

Swingle and co-workers have reported that deficiency of adrenal cortex hormone results in increased permeability of capillaries and loss of plasma with blood concentration and serious reduction in circulating blood volume. They assume that this plays a role in surgical shock but clinical studies are wanting for substantiation of the view. Prolonged low blood pressure from any cause increases capillary permeability with loss of plasma and

eventually of erythrocytes with irreparable damage. Blalock has recently shown that this holds for hæmorrhage and that after blood pressure has been low from this cause for three or more hours abundant blood transfusion fails to arrest the escape of plasma and blood and to rehabilitate the circulation.

Clinical experience has shown that as long as permeability has not been seriously damaged, low blood pressures usually respond to fluid administration—best to blood transfusion but also well to physiological salt solution. But when the permeability has become too great, whether from nervous influences, hæmorrhage, local trauma, prolonged constriction, burns, or freezing, the administration of fluids serves to increase the amount of plasma poured out of the circulation either locally or generally, or both, and a fatal termination is the almost inevitable result.

D. B. PHIFISTER



# EARLY AMERICAN HOSPITALS

## THE WOMEN AND CHILDREN'S HOSPITAL

BEULAH CUSHMAN, B. S., M. D., CHICAGO, ILLINOIS

To write the history of the Women and Children's Hospital, one must go back farther than the day when the doors first opened on the modest little dispensary and hospital that has gradually grown to an organization of its present size. One must go back to 1829, to the birth of Doctor Mary Thompson, who as a pioneer woman in medicine, organized the small unit to serve the immediate needs of women and children more or less deservingly following the Civil War. She dreamed dreams as she worked tirelessly to realize her ambition—dreams that were kept alive, in spite of many trials, finally to materialize into the present organization.

Doctor Mary Thompson was born in New York State, was educated in the East, and came to Chicago in 1863. She had been preceded by two women who had made an unsuccessful attempt to found a dispensary for women and children, but their plans had been abandoned. At the time Doctor Thompson came to Chicago there were two hospitals in the city. Neither permitted women physicians to utilize their facilities and one did not accept women patients. At this time the Civil War was at its height. Medical facilities were limited for those not actually engaged in the war, since most of the physicians had been enlisted for services on the battlefield. Drugs were difficult to obtain, and few people had the money to pay for them. Friends of Doctor Thompson appealed to her to help alleviate the suffering of the women and children of the city as well as of the many people who had migrated to Chicago from the East. She organized a dispensary and arranged with a group of druggists to provide medicine at reduced prices. Many of these patients, however, were unable to benefit by the medical advice and care that she could provide because they in some cases had long distances to travel to and from the dispensary and were not in physical condition to stand the strain. Out of this pressing need, in the winter of 1864-65, the plans for the founding of a new hospital were formed. On May 8, 1865, a building situated at Rush and Indiana Avenue, was opened. It provided 14 hospital beds, a dispensary, and a drug room. During this first year the hospital treated 203 patients. The charge was presumably five dollars a week, but it is recorded that out of the 203 patients only one patient paid in full for her care.

In its second year the hospital had already outgrown its facilities and was therefore moved to a residence at 212 Ohio Street. It was while located here that the hospital met its first opposition. A petition was filed against it as a "nuisance." The original incentive for this move seemed to be that a man wished to rent for a stable the barn of the residence, which was served at the time as a laundry for the hospital. The

Proposed plan for new hospital



The Women and Children's Hospital

charge was investigated, the health department reported that the laundry was "clean and healthy," and the institution was allowed to continue.

Three years later the hospital again needed larger quarters, and this time it was established at 402 N State Street. It remained there until 1871, when unfortunately the hospital was one of the victims of the great Chicago fire. In 5 minutes, according to one dramatic report, the building was burned to the ground. The patients were transferred to another house, but they were soon again forced to leave because the fire had spread. All of the material assets of the hospital were wiped out save for two pillows, a blanket, and a piece of carpet.

With these remnants, at the instance of the late F B Gardner, Mrs W G Dyas and other interested friends a vacant house was taken at 598 West Adams Street which was soon carpeted with mattresses and patients from attic to basement. No bedsteads could be had at the time. Here helpless women and children suffering from general sickness induced by fright exposure to excessive fatigue and fire followed by cold rains were given food and medicine. On the 23rd of December 1871 the Hospital was moved by the Aid and Relief Society to the Barracks on Throop and Harrison Streets. When the demands produced by the fire had ceased, it moved in April, 1872, to 157 Center Avenue, where it remained until the opening of the earlier building at Adams and Paulina Streets, February 26, 1873. In 1873, in acknowledgment of public service, the Relief and Aid Society gave the hospital \$25,000.00 with which the site at Adams and Paulina Streets was purchased. The commodious house on this site was transformed into a hospital, the small barn on the rear of the lot being used for the Women's Medical School. In 1873 it founded the first training school for nurses in the middle west. In 1885 the hospital moved into a five story brick and stone building specially planned for it. The new building, at Paulina and Adams Streets, was opened December 10, 1885, and remained the home of the organization until the opening of the present hospital at Ashland and Maypole Avenues in January 1929, the present building providing facilities for 100 patients.

In glancing through the records of the hospital one finds many interesting little touches that must have been of great significance to the hos-

pital. Food is frequently mentioned, from which we may gather that the endowment of the hospital was so meager that even its immediate needs had to be met by the generosity of friends. Pillow cases, garments for the patients, quilts, and similar equipment were provided by individuals and groups. Material for bandages was provided by gifts of old linen. The Third Presbyterian Church contributed one and a half gallons of wine.

The present hospital is a very different institution from that formulated out of the needs of Chicago during the Civil War. The hospital's staff is composed entirely of women physicians. It offers surgical, medical, and obstetrical care, maintains a well equipped X ray department, which is adequate not only to aid in diagnosis but also to carry out treatment as indicated. The hospital also operates the third largest dispensary service in the city. The Emergency Welfare Relief provides a fund for the care of 20 hospital patients and 65 dispensary patients a day. The institution sustains a standard of work that makes it acceptable by the American Medical Association for the training of internes. A home for nurses was maintained from 1873 to 1930.

One of the unique branches of the work of the hospital is The Mother's Milk Bureau, organized and established by Dr Bertha Van Hoesen in 1930. This organization furnishes mother's milk to the hospitals in the city for babies who are undernourished or for some reason do not tolerate the usual artificial formulas. The milk is obtained from mothers who have undergone very complete physical examinations, and whose babies not only are not using all of the milk the mother has, but are also found to be doing well on the mother's milk. They are consuming. The donors and their babies are carefully supervised to ascertain that the mother eats properly and that her own baby is not being sacrificed for the financial remuneration the milk brings. The milk is collected with great care, is transported in special ice containers, and is never used if more than 24 hours old. The Bureau distributes about 1500 ounces a month, part of that being given away to families unable to pay for it, for the slogan of the organization promises that no baby in Chicago shall die for lack of mother's milk. This department was founded in 1930 and has its distributing center at the Women and Children's Hospital.

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

has labored diligently to include in this new edition the worth while contributions of the past few years

AN literary work which teaches its fourteenth seven foreign languages has achieved a position of unquestioned importance. May's *Diseases of the Eye* made its first appearance in 1900 and for many years has been probably the most widely used text on the eye for general practitioners and medical students, both in the United States and in several other countries. During the past year the seventh British, the sixth Italian, and the third

Chinese editions have been issued. The secret of this wide universal acceptance has been the fulfillment of the original conception of the author to create a book on the eye not for the ophthalmologist but for the student of medicine and the general practitioner of medicine. Theoretical considerations, detailed discussions and descriptions, and the more unusual ocular conditions are carefully avoided or only briefly mentioned. The language is concise, simple, and explicit. There are many excellent illustrations, including two new colored fundus plates.

A much of the material has been rewritten for this fourteenth edition, in an attempt to eliminate the obsolete practices usually carried along from one edition to another in works of this kind. The new treatment of retinal detachment has been ably handled and brought up to date, there have been revisions on anatomy, pathology, and ocular mobility.

It may be questioned that ophthalmological optics and refraction should be assigned 63 pages in a work of this scope, intended for and used by the specialist. It is too detailed for the former and insufficient for the latter. Many minor criticisms might be offered on such points as the role of the staphylococcus in the production of acute conjunctivitis, the importance of pain as a leading symptom of retrobulbar neuritis, the rather frequent mention of the use of leeches, and similar points not strictly in keeping with modern practice.

The fine points of this book are too numerous for a few faults to outweigh them and with the improvements and revisions of the present edition it should

TO us as medical students 20 years ago two textbooks of surgery seemed to stand out from a considerable number of available and popular one volume works because of their conciseness, their clarity of expression, and their stimulating interest. To these, Stewart's *Manual of Surgery* and DeQuervain's *Surgical Diagnosis*, has in recent years been added a third, which is the best single volume work covering the field of surgery that we have had the opportunity of reading.

The necessity for a third edition of Homans' *Textbook of Surgery* only 4 years after its introduction to the medical profession indicates how popular it has become in this short period. Many features contribute to this well deserved popularity. The book is, first of all, an attractive and pleasing example of the book maker's art, and truly, illustrations are well chosen, carefully drawn, and truly, illustrations are well chosen, size and needless emphasis on trivial details, the historical sketches which introduce many subjects provide a background which is both interesting and essential to the student who would truly grasp surgical principles and practice, the bibliographical index is exceptionally complete and ingeniously arranged to enable the reader to find quickly the source of the author's material. Finally, and of the greatest importance, is the well balanced presentation of the tremendous number of subjects included in general surgery. To have taken the lectures and papers of many different individuals interested in widely separated fields of surgery, to have welded them into a homogeneous whole, to have filled in the many gaps unthought of by the authors' associates, and to have omitted so wisely the absolute material that has been allowed to encumber many of the older books, and to have produced finally a textbook of surgery seems to us an admirable achievement and one that deserves unstinted praise.

With specific reference to the new edition, the publishers list on the inside page of the jacket some thirty subjects "which have undergone correction or been newly introduced in the third edition." "The new material," in the author's preface, "has been incorporated without a change in pagination, under the plan that for everything fresh that comes in something stale must go out." We have not been able to recognize the "stale that has gone out," but have seen many evidences that the author's *Textbook of Surgery* By John Homans M.D. 3d ed. Springfield, Illinois and Baltimore Md. 1914

continue to occupy first place in popularity among students and practitioners of general medicine

WILLIAM A. MANN, JR.

THE new edition of *A Textbook of Bacteriology*<sup>1</sup> by Zinsler and Bayne Jones, is remarkable for the extent to which it has been brought up to date. But even more so is the element of fair judgment with which the authors have evaluated the wide variety of recently published articles.

Even the recent medical graduate who examines this book will find evidence of new and major advances in the subject of bacteriology with definite bearing on clinical medicine. The older graduate will note that a veritable flood has passed under the bridge since his day as student of this science.

The authors have taken a definite forward step in selecting and presenting materials so as to indicate the application of bacteriology and immunology to clinical medicine rather than to present the strictly diagnostic aspect. Yet at the same time they have made available a wealth of information which has been adequately digested and correlated so as to elucidate biological principles.

This book has particular value as a reference volume giving to its reader information published as late as 1934. The material has been fairly judged by the authors and presented in a manner that makes it readily available. As to its use as a textbook for medical students, one wonders if the average medical curriculum allows to the course in bacteriology sufficient time for the student to cover adequately the essentials in this book.

The chapters on the bacteriology of milk and water have been eliminated to provide as stated by the authors in the preface "space for a presentation of some of the great mass of newly acquired material." One wonders if the time has not come when the chapter on parasitology can be omitted from textbooks of bacteriology and given over to the protozoologist for parasitology seems in some respects less related to the science of bacteriology than does the bacterial content of milk and water and their sanitary significance.

The recent developments in bacteriology have more prominent place in this book.

The newer infectious diseases, as tularæmia and undulant fever are more extensively described and discussed than usual.

Among the more recently developed and important fields of immunology bearing directly on clinical medicine is that of the soluble specific substances. This subject is adequately handled as would be expected since the senior author was a pioneer in this field. Bacteriophage therapy is discussed in the light of recent experimental studies and its value as a therapeutic agent is questioned. More space might have been devoted to the presenta-

tion and discussion of the experimental evidence on which the authors based their conclusions, since bacteriophage has been so widely heralded as a panacea in the treatment of infections.

In this book the authors have emphasized the facts and established principles of the science of bacteriology. The unestablished and theoretical has been fully presented and different opinions on controversial subjects presented and controversially discussed.

ARTHUR W. WALKER.

THE recent publication of the fifth edition of Professor Fohn's *Laboratory Manual of Biological Chemistry, with Supplement*<sup>2</sup> again brings to date a volume outstanding because of the originality and productivity of its author whose methods comprise a large part of the contents. The arrangement is the same as in previous editions, the material designed essentially for class instruction being arranged in a series of ten parts dealing with elementary considerations of volumetric analysis, catalysis and enzyme action, fats, carbohydrates, proteins, urine analysis and metabolism, blood, bone and bile. Wherever possible, quantitative methods of study are presented, there being a minimum of purely qualitative experiments.

The discussion (Part 1) of the essential elements of chemical equilibrium, the proper selection of an indicator for titration and what occurs during the titration of an acid and base is so clearly and simply presented as to be within the comprehension of any non-mathematical student. One wishes, however, that a few simple experiments had been devised to illustrate the principles discussed. The material contained in Part 5 on proteins is devoted chiefly to color reactions and precipitation tests. In view of the amphoteric nature of protein it seems to the reviewer that a section devoted to colloidal chemistry or to a few experiments illustrative of the colloidal behavior of proteins could be added with advantage.

An experiment on the isoelectric precipitation of protein would acquaint the student with a method in general use in research and industry today. The methods of quantitative urine analysis are introduced in Part 6. Significant changes have been made in the uric acid method which diminishes the interference by polyphenols and other substances. Parts 7 to 10 remain the same as in earlier editions.

Probably the most valuable material of the book is contained in the supplement. The section has undergone the greatest revision. Professor Fohn has discussed in detail the various steps in the more complicated procedures of blood and urine analysis where difficulty may be experienced in learning the methods. In the section on urinalysis a tentative colorimetric method for the determination of phenols has been introduced. Lloyd's reagent and oxalic acid being used to remove the interfering uric acid. In the section on blood analysis the use of an unlabeled

<sup>1</sup>A TEXTBOOK OF BACTERIOLOGY WITH A SECTION ON PATHOGENIC PROTOZOA. The Application of Bacteriology and Immunology to the Etiology, Diagnosis, Specific Therapy and Prevention of Infectious Diseases. By HANS ZINSLER, M.D. and STANHOPE BAYNE-JONES, M.D. 14th revised. New York and London: D. Appleton-Century Co., Inc. 1934.

<sup>2</sup>LABORATORY MANUAL OF BIOLOGICAL CHEMISTRY WITH SUPPLEMENT. By Otto Fohn. 5th ed. New York and London: D. Appleton-Century Co., Inc. 1934.

The publication contains further statistical data and the methods of treatment of other forms of neoplasms. It is quite evident from this publication that this group is making a sound and intelligent effort to execute modern cancer therapy.

M. V. CUTLER

**A REMARKABLE** book is *Cirugía Gástrica*; The author, Manuel Corrachan, is a distinguished professor of surgical pathology in the medical school at Barcelona and chief surgeon to a large hospital. He has had a large clinical material, and one needs only to glance at the extensive and well chosen bibliography scattered throughout the book to see that he has been a tremendous reader. Remarkable for a European is the fact that he is thoroughly conversant with American contributions as well as with those of his own country, France, England, and Germany. The book is beautifully printed on fine paper and it is beautifully bound. It would be a source of lifelong pride to any publisher in the world. The illustrations are many and they are well reproduced.

Particularly remarkable is the lavishness with which good colored photographs have been used. Many of the roentgenograms are particularly interesting because the technique of Berg and others has been used to show the folds of the gastric mucosa. It is unfortunate that so few American surgeons read Spanish, for there is much in this book to interest and help them. Actually, there is no book in English covering the field so extensively or so beautifully as this volume and its companion will do.

A large part of the book is taken up with hints on the examination of the patient. There is much valuable material also on the anatomy, physiology, and pathology of the stomach. There are beautifully colored reproductions of what can be seen through the gastroscope.

Much space is given, as one would expect, to the problems of ulcer and cancer. In addition, many pages are given to the discussion of the rarer lesions of the stomach.

The author gives more space to problems of gastritis and gastropyloritis than most American surgeons would give. So far as operating for pyloritis goes, he points out wisely that even if an operation is done, the patient must be treated medically for a long time, with rest and an over feeding diet.

About the only criticism that one might make after reading here and there through the book is that the author might well have trusted more to his own experience and wisdom and less to his extensive knowledge of what others have written. The physician or surgeon looking for help is grateful to the man who has prepared a good review or abstract for fresh statements by a man of wide experience.

*Cirugía Gástrica*. By Dr. Manuel Corrachan. Vol. 1. Barcelona: Salvat Editores, 1934. (775 pages.)

The minimum must be one effective instrument. The minimum must be one gram, preferably it should contain two grams.

The Cancer Control Organization for Edinburgh and Southeast Scotland was inaugurated on March 2, 1934. The purpose of the organization is the investigation, the care, and the control of cancer. The volume reviewed here is the first publication of the new organization and presents a statistical survey of the results of the treatment of cancer in the Royal Infirmary.

The introductory chapter consists of the chairman's address by Mr. J. M. Shaw. If this small volume contains nothing more than the chairman's address, its publication would have been fully justified. Those who have attempted to pronounce a brief but comprehensive statement of the cancer problem to a mixed audience fully appreciate the difficulty of this task. Mr. Shaw has accomplished this task admirably.

The presentation is clear, concise, and beautifully composed. The point of view is sound and well balanced. No one who is interested in the subject of cancer control should fail to read it. Three hundred and thirty-three cases of carcinoma of the female breast and one carcinoma of the male breast are analyzed. The radical operation, sometimes combined with radiation, has been the treatment of choice in the operable group.

It is quite evident that one of the important handicaps in the work of this institution is the inadequacy of radium facilities. The radium bomb does not contain sufficient radium to prove an adequate source of radium for the Cancer Control Organization for Edinburgh and Southeast Scotland. E. & S. Livingstone, 1934.

*Cancer—Edinburgh 1934*. Published by The Cancer Control Organization for Edinburgh and Southeast Scotland. Edinburgh: E. & S. Livingstone, 1934.

The second volume is to contain chapters on pre operative and postoperative care, anæsthesia, indications for, and technique of, the various operations on the stomach rare or disused operations, the stomach that has been operated on the results of the various operations, and the bad results sometimes obtained after gastro-enterostomy and gastrectomy

CHARLES H. MAYO  
WALTER C. ALVAREZ

THE volume<sup>1</sup> entitled *Foreign Body in Air and Food Passages* by Drs. Chevalier and C. L. Jackson has long been awaited both by the roentgenologist and endoscopist and neither will be disappointed as it fulfills all pre publication expectations. Coming from the pen of the Jacksons it is quite natural and necessary for it to be simple and lucid yet complete in every detail.

The book falls into eight main sections devoted chiefly to differential diagnosis of both radiopaque and radioparent foreign bodies from an X ray standpoint although the associated pathology is not neglected. Accompanied by 150 X ray reproductions with descriptive legend of all types of cases there is very little if anything overlooked. Thus it is very easy to follow the authors through the description of a drowned lung as compared to a pulmonary abscess or what the roentgenologist might expect from the reaction of tissues to foreign bodies of certain chemical or physical properties.

A very valuable chapter is devoted to fluoroscopic endoscopy in which the biplane fluoroscope is used to great advantage.

The book is filled with valuable axioms learned from years of clinical experience and over 3,000 cases of foreign body in the air and food passages. Written from such a large store of material it deserves high praise for concrete knowledge it discloses and its quality will give it more than a temporary success.

JOHN F. DELPH

IN the third edition of Slemons' book<sup>2</sup> on the prospective mother changes have been made in many subjects especially the arrangement of the diet, the gain in weight during pregnancy, the employment of the X ray for greater accuracy of diagnosis, the rôle of the endocrine glands in the menstrual cycle and the modern methods of anesthesia at the time of birth.

The reviewer has never believed that pregnant women should be told as much of the anatomy and physiology of pregnancy and labor as this book discloses. The smattering of information which the patient obtains is apt to be misapplied and misinterpreted.

Teachers of obstetrics realize how difficult it is for medical students to grasp the normal in obstet-

<sup>1</sup>ANNALS OF ROENTGENOLOGY A SERIES OF MONOGRAPHIC ATLASSES Edited by James T. Case, M.D. Vol. XVI—FOREIGN BODY IN AIR AND FOOD PASSAGES By Chevalier and Jackson, M.D. and Chevalier L. Jackson, M.D. New York, Paul B. Hoeber, Inc. 1934.

<sup>2</sup>THE PROSPECTIVE MOTHER: A HANDBOOK FOR WOMEN DURING PREGNANCY By J. Morris Slemons, M.D. New York: D. Appleton Century Co. Inc. 1934.

rics. What sort of grasp will the layman get in this short course in obstetrics?

The rest of the information is well given.

In the reviewer's opinion, all the information a lay woman needs on the subject of the prospective mother could be stated in fewer than 311 pages, many obstetricians find a booklet of 16 to 20 pages ample.

To those who do not agree with him, the reviewer recommends this as a good book.

EDWARD I. CORNELL

THE discovery of the sympathetic nervous system by the surgeon has been a recent affair, though the neuro anatomist and physiologist have been contributing for many years to our knowledge of this regulator of our body's internal economy. Like most fundamental discoveries in science the facts set forth by these experimentalists became general property only when it was shown that somehow and in some way the involuntary control over our blood vessels, glands, and viscera might be influenced by various surgical operations.

So rapid was this invasion of a new surgical field that many procedures were advocated which opposed all known anatomical or physiological facts. In truth it was only after several years during which the literature was crowded with publications, that surgeons found that many times they did not fully understand one another. So we find them now solemnly emphasizing that by the 'sympathetic system, they mean that part of the autonomic nervous system represented in the thoracic lumbar outflow. Familiarity with the known facts in the beginning might have made surgical progress more sure and perhaps less bombastic.

During the last 10 years claims for the relief of the spasticity of muscles following lesions of the central nervous system have been disproven step by step. Recently, the careful reporting of observations upon patients operated upon for vascular diseases of the extremities has added to the scientific data which must be balanced in the final judgment upon operations designed to give much needed relief to unfortunate patients. It is unfortunate that the critical unprejudiced judgment of the laboratory worker is not always employed by the surgeon in evaluating the results of his operations. Surely, it is not enough to say empirically, 'the patient says he feels better'.

Early in their book<sup>3</sup> Gask and Ross lead one to believe that their evaluation of the surgery of the sympathetic nervous system is to be a critical one. Unfortunately they do not hew to the line throughout, for example their acceptance of Lewis' contention that removal of the sympathetic supply to an extremity does not prevent the occurrence of attacks of vasoconstriction in Raynaud's disease. Careful examination of surface temperature changes properly

<sup>3</sup>THE SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM By George E. Gask, C.M.A., D.S.O. F.R.C.S.(Eng.) and J. Paterson Ross, M.S.(Lond.) F.R.C.S.(Eng.) Baltimore: William Wood & Co. 1934.

controlled and of blood volume changes in the fingers will support that view. These are the facts which the surgeon can add which will be of some ultimate value. It is surprising that the authors, after pointing out correctly that the assumption on which perenteral sympathectomy was based is incorrect, devote so much space to the subject and do not insist upon an evaluation of the claimed clinical results similar to those employed by Lewis in his study of the results of operations for Raynaud's disease. Again, we read "It would be unwise to advocate this operation (perenteral sympathectomy) in the treatment of Raynaud's disease or thromboangiitis obliterans, though occasionally an astonishing improvement may occur in the later stages."

The strongest argument for perenteral sympathectomy would seem to be the statements that pain is relieved by such an operation. Inasmuch as the relief of vascular origin is relieved. Certainly, it should be pointed out that not all cases of causalgia can be relieved by such an operation. Inasmuch as the course of the vessels, it is difficult to understand how the pathway is broken unless by chance the operation is performed above the site of the lesion the exact nature or location of which is commonly unknown.

It is disappointing that the battle between their criteria to the results of their operations and their surgical belief that some clinical good must come of an operation for which they have no scientific factual basis, should have led the authors to champion a graphic data which could be interpreted by their readers. For example, does a patient with removal of the perenteral nerve supply to the radial or brachial artery respond to a stimulus of the human body? Finally, that the authors realize the necessity for accepting an open but critical mind on this entire business of the surgical attack upon the sympathetic nervous system is obvious in their last sentence: "until more is known about the pathology of the sympathetic system, the place of surgery in the treatment of its disorders cannot be firmly established."

THE author of this monograph, Dr. McTier, has presented a remarkably clear and comprehensive picture of the problem of acute intestinal obstruction from both the clinical and experimental viewpoint. It is the best analysis that has yet appeared and deserves a place with the classic papers in this field. The author and his associates have made a very important and fundamental contribution to our knowledge of the cause of death in acute intestinal

The last section contains an excellent summary of the experimental work that has been done to determine the cause of death. The relative significance of dehydration, due to loss of the various digestive secretions, and toxemia, due to absorption from the proximal intestine, in observations at varying levels in the gastro intestinal tract and with varying degrees of circulatory interference to the bowel wall is ably presented and the conclusions drawn are logical in the light of present knowledge. Every general surgeon and everyone interested in the problem of intestinal obstruction from the experimental standpoint should read this book.

THE first edition of Stokes' excellent monograph on syphilology was published in 1926. In the second edition, the book has been enlarged and 25 of the 23 chapters have been rewritten. A new chapter on release and progression is another improvement. The first edition had, as a definite aim, the presentation of the subject to the completely uninitiated.

LESTER R. DRASOSTEDT

Stokes' Clinical Syphilology  
 Revised Edition  
 By John H. Stokes, M.D.  
 London: W. B. Saunders Co. 1934

Hogben's Surgical Nomenclature  
 Acute Intestinal Obstruction  
 By Monroe A. McTier, M.D.  
 New York: Paul B. Hoeber Inc. 1934

# CORRESPONDENCE

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# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

APRIL, 1935

NUMBER 4

VOLUME 60

## LATE COMPLICATIONS IN IRRADIATION TREATMENT OF CANCER OF CERVIX<sup>1</sup>

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THE effective treatment of cancer of the cervix often necessarily carries considerable risk to the patient. The risk is less with irradiation than with operation, but irradiation carries definite dangers. The serious responsibility and difficult problems in the use of radium in this situation are not generally appreciated. If the dose is too small, the distant cancer cells survive and the patient dies of recurrence. If the dosage is pushed to the point of causing devitalization of the out-lying cancer cells, there is danger of irradiation injury of the rectum and bladder and the ureters.

To give the patient the best chance of cure and at the same time to hold local injury to the minimum, require expert study of the particular conditions present in the pelvis in each case, and a careful adaptation of every means to the administering of the maximum dosage permitted by those conditions. In this work, thorough knowledge of pelvic anatomy and pathology with training and experience in accurate palpation must be combined with radium knowledge and experience in order to give the patient the chance for life to which this work should have substantial training in both gynecology and radiology.

In the Washington University Medical School and Barnes Hospital, we have been

Presented before the Texas Association of Obstetricians and Gynecologists, San Antonio, Texas, September 30, 1934.  
From the Department of Obstetrics and Gynecology, Washington University School of Medicine and Barnes Hospital.  
1. J. Obst. & Gynec. 1934, 53, 450.

screening of the bladder and rectum was secured by firm packing adapted to the particular conditions present. In most of the cases of this series, the course of treatment was started with the radium implantation. The details of the X-ray treatments are given in each case showing subcutaneous infiltration.

#### RECTAL STRICTURES

**CASE 1.** J. P. aged 44 years. In May 1923 received 4800 milligram hours of radium for a squamous cell carcinoma of cervix of clinical stage II. League of Nations International Classification. In this case radical abdominal operation was employed the operation being carried out a few days after the finish of the radium dosage (which was given in two treatments with an interval of 4 weeks). Following the operation the patient received deep X-ray therapy.

Two years after treatment. August 1925 a rectal stricture was found. It was adjacent to the cervix area where the radium had been applied. It admitted the tip of the finger and was easily dilated the walls being thin and without extensive induration. There was no indication of cancer in the rectum or elsewhere. In 1928 there was still slight narrowing but no symptoms from it. In June, 1930, there was no disturbance from the rectum or vicinity and no evidence of cancer. In February, 1931 the patient developed symptoms of brain tumor from which she died 4 months later. No evidence of cancer in pelvis. An autopsy was not obtained.

**CASE 2.** B. S. aged 46 years. In October 1930 patient received 4500 milligram hours of radium for squamous cell carcinoma of cervix of clinical stage III, and also the usual deep X-ray therapy. In July, 1932 there was definite rectal constriction in the cervical region. This was easily kept open so that there were no troublesome symptoms but there was still some constriction at examination in June 1934. There was no evidence of recurrence of the carcinoma. This patient had also a second degree X-ray infiltration of the abdominal wall (see under late X-ray effects).

**CASE 3.** S. L. aged 43 years. In September, 1931 patient received 3000 milligram hours of radium for a squamous cell carcinoma of cervix of clinical stage III followed by deep X-ray therapy. In a routine check up examination in September 1933 a rectal stricture was found opposite the cervix. It was wide and admitted the finger easily for dilatation and had given no special trouble. In April 1934 the rectal stricture was about the same. There was no evidence of recurrence of the cancer.

**CASE 4.** S. G. aged 61 years. In September 1932 patient received 4000 milligram hours of radium for squamous cell carcinoma of clinical stage III, and the usual deep X-ray therapy. Check up examination showed no evidence of recurrence of the cancer.

but in the examination in August 1933 a rectal stricture was found. This was adjacent to the cervix, and the walls were thick and firm. The opening was small and was dilated with some difficulty. In March, 1934, the stricture was causing no trouble. It is to be noted that this stricture gave trouble about a year after treatment, while those previously mentioned were not noticed until 2 years after treatment.

**CASE 5.** L. F. aged 45 years. In February, 1932 patient received 3000 milligram hours of radium for squamous cell carcinoma of cervix of clinical stage III and also deep X-ray therapy. This case gives a clear indication of the etiology of these strictures. We have come to expect considerable rectal irritation in the effective irradiation treatment of carcinoma of the cervix the rectal mucosa apparently being more susceptible to the acute effect than the bladder mucosa. Ordinarily the rectal irritation subsides after 2 or 3 weeks without further trouble. In some instances, however, the rectal irritation progresses to ulceration and infiltration with subsequent stricture formation.

In this case the rectal irritation persisted and after 3 months (in May, 1932) there was definite ulceration. This gradually healed but with evident beginning stricture from the scar tissue. This emphasizes the importance of investigation and treatment of any persisting rectal symptoms, and also of rectal palpation in the check up examinations of these cancer patients. This patient had also a first degree X-ray infiltration of the skin of the abdominal wall (see under late X-ray effects).

#### BLADDER ULCERATION

**CASE 1.** B. H. aged 45 years. In June 1923, received 3800 milligram hours of radium (in two treatments close together) for squamous cell carcinoma of cervix of clinical stage late II and also the regular deep X-ray therapy. Patient remained in good health for 3 years (until August, 1926) when she complained of bladder symptoms and the passing of bloody urine. Cystoscopic examination revealed a small ulcer in the bladder opposite the cervical region. This healed promptly under silver nitrate irrigations and the bladder symptoms disappeared. There was no evidence of recurrence of the cancer. Subsequent check up examinations showed no evidence of recurrence of the cancer and no bladder disturbance. In an examination in June, 1930, the patient showed a marked hypertension and in December she died of apoplexy. No autopsy was obtained.

**CASE 2.** E. P. aged 33, in September, 1923, received 3000 milligram hours of radium for squamous cell carcinoma of cervix of clinical stage III. The patient received also deep X-ray therapy of which details will be given later as this is the patient with

ment and appearance of bladder trouble was 3 years, 2½ years, 6 years, and 3 years, respectively. The bladder symptoms developed rather suddenly and were soon followed by bloody urine. Cystoscopic examination showed a fairly uniform picture consisting of a devitalized area or ulcer with radiating dilated blood vessels (Fig 1 from transverse). The area bled easily when traumatized. Specimens removed through the cystoscope showed chronic inflammation without malignancy. In these particular cases the subsequent history showed the absence of accompanying malignancy although such a non malignant lesion might occur in a case showing recurrent cancer activity either at that time or later. The lesion and resulting bladder symptoms yielded fairly well to irrigations and instillations, but only one case

#### STOULING OF SKIN

Pigmentation of the skin is, of course, to be expected over portals of entry for therapeutic local significance. The late complication here referred to is a marked subcutaneous infiltration, which caused thickening and irregularity of the skin and was later followed by sloughing.

Case L. P., aged 33 years, in September, 1925, received 3000 milligram hours of radium for squamous cell carcinoma of cervix of clinical stage III, and also deep X-ray therapy. The X-ray therapy was given in treatments on September 9, 1925. No further treatment was given until November 26, 1926, May 7, 1926, July 25, 1926, and November 26, 1926. Each dose (given in two areas—one front and one back), milliamperes 30, time, 13 minutes, kilovolts, 200, filter, 1 millimeter copper, 1 millimeter aluminum, portal 20 centimeters, distance 50 centimeters. Check up examinations from time to time showed the pelvis clear of evidence of recurrence of the cancer. As early as the latter part of 1926 it was noticed that there was an infiltration of the skin over an area of about 6 by 7 centimeters on the lower abdomen just above the symphysis pubis. Besides being highly pigmented, the skin was somewhat edematous, with a deep, firm infiltration. There was a smaller area presenting similar characteristics posteriorly over the sacrum. In October, 1927, the subcutaneous infiltration had increased and definite telangiectasis was appearing in the areas (Figure 2 from transverse). A very good idea of the condition of the abdominal wall at this time. In March, 1928,

sloughing of the skin mentioned under late X-ray complications. In March, 1928, this patient complained of bladder symptoms, and on vaginal palpation there was a firm infiltration involving the bladder wall near the cervix. Cystoscopic examination showed just beyond the trigone an area of dilated blood vessels radiating somewhat like the spokes of a wheel (Figure 1 from transverse) gives a very good representation of the cystoscopic appearance. The vessels bled easily when traumatized. A small piece of tissue was removed from the area by Dr J. R. Gault, who had charge of the cystoscopic work in these cases. Microscopic investigation of the removed tissue showed chronic inflammation, but no malignancy. No further treatment was stopped the bleeding, and the bladder irritability gradually lessened. In June, 1934, there had been no more blood urine and the bladder symptoms were greatly improved.

Case 4. A. S., aged 46 years, in August, 1929, received 3000 milligram hours of radium for adenocarcinoma of cervix of clinical stage III, and the regular deep X-ray therapy. The patient had also myoma of uterus and exophthalmic goiter, and received medical treatment for the latter. The patient was in good health until July, 1932, when she began to have bladder distress and passed bloody urine. Cystoscopic examination revealed numerous dilated blood vessels in the portion of bladder opposite the cervix. Between the vessels, the bladder wall was pale and, in the center, was a grayish area. The entire field involved was about 3 by 4 centimeters, and it bled easily when touched. Scrapings removed through the cystoscope showed chronic inflammation but no malignancy. The bleeding was easily controlled by irrigations and instillations. Check up examinations in July and September, 1933, showed absence of any further bleeding and no much bladder distention. At no time was there evidence of recurrence of the cancer for which treatment was given in 1929.

Of these 4 cases of late bladder complications the interval between irradiation treat-

the patient developed an ulcer of the bladder, which is reported as Case 2 under bladder ulceration. This yielded to treatment as previously mentioned. The abdominal wall infiltration showed increasing telangiectasis and serious local irritation. Figure 3 (frontispiece) shows the condition of the abdominal wall at this time.

The patient disappeared and did not return until October 1932. As the reason for not returning, she stated the skin of the lower abdomen sloughed a way keeping her in bed for a period of 18 months. Apparently an area about the size of the hand in the involved region of the lower abdomen had necrosed. The necrosed skin had sloughed away to the subcutaneous tissue leaving a large granulating surface. The patient was very stout with overhanging abdominal wall and the granulating surfaces, being approximated had healed together. At the visit in October 1932 the process of healing was only partly completed. There was still a small granulating area in the right side and the healed area was tender. On her return September 11, 1933, the abdomen was entirely healed. The line of scar tissue is shown in the photograph in Figure 4. In the right side of the scar there was an infiltrated area forming a small nodule. This was excised for microscopic investigation and showed chronic inflammation with out malignancy. Over the sacral area there was much infiltration and vascularization, but no sloughing. The photograph in Figure 5 is to show this area of discoloration. Naturally we have been watching the abdominal surface for malignant change but so far none has appeared. At the last examination in June 1934 the patient was in good general health, and up and about her work without serious discomfort. At no time has there been any evidence of recurrence of the cancer for which she received treatment in 1925.

As to the etiology of this complication—why it appears in an occasional individual and not in others—the idiosyncrasies of the patient with the special reactions of her skin and subcutaneous tissues and blood and lymph must be taken into consideration. It is to be hoped that the study of this and allied conditions will develop some method of spotting those individuals with handicaps which limit their capacity to stand deep roentgenization.

In the course of check up examinations we have noted two lesser grades of what appears to be this same process. One case showed a very mild change in the skin and subcutaneous tissue.

This patient, aged 45, was given radium and deep X ray therapy in February 1932. She developed a marked proctitis with some ulceration and later a rectal stricture, which is reported as Case 5 under

rectal strictures. The X ray therapy consisted of 1030 r to lower abdomen on February 16, 1932, and 850 r to lower back on February 17, 1932. May 19, 1932 the patient complained of pain in the lower abdomen and vulva and thighs. Examination showed the abdomen markedly pigmented below the umbilicus with absence of pubic hair. No special vascularity was seen. There was some deep infiltration, causing thickening and irregularity of the skin. In June, 1934 the condition remained about the same.

Another case showed what may be designated as the second stage of the process, in which there was obvious vascular change in the form of telangiectasis.

This patient, aged 46 years, received radium and X ray therapy in October, 1930. She developed a mild rectal stricture, and is reported as Case 2 under rectal strictures. The X ray therapy consisted of 900 r to lower abdomen on September 30, 1930, and 1000 r to lower back on October 1, 1930.

In the examination in June 1932 it was noted that there was chronic infiltration of the abdominal wall with some superficial vascularity. By December 1932, the condition of the wall was definitely worse, the skin being raised in parallel ridges. In September, 1933 the process showed no further progress, giving the impression that it had reached its maximum. June 1934 the telangiectasis was more marked, pain in the abdominal wall was increasing and the condition was becoming definitely worse.

#### GENERAL PLAN OF IRRADIATION TREATMENT

In order to improve the follow up in our cancer cases and better co ordinate the work of the various services required in their treatment we established some years ago a gynecological cancer clinic. This clinic is held every Tuesday afternoon and all cancer cases of the general gynecological clinic are referred to it. A special history is made in each case, and a careful description of the growth recorded. The clinical classification of the cancer is made as far as conditions will permit, placing it in stage I, II, III, or IV of the League of Nations International Classification. A specimen is taken and sent to the laboratory for microscopic investigation and a bacterial culture also is taken from the growth, as a control in clearing up the pyogenic infection which is usually present. Antiseptic douches are begun to be continued while the special treatment for the cancer is being carried out. The patient is immediately turned over to the



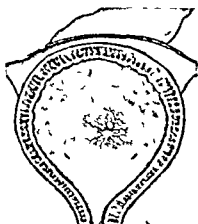


Fig 1 Late devitalization ulcer of bladder appearing 6 years after irradiation treatment of carcinoma of cervix uteri. The grayish appearance with numerous dilated blood vessels radiating toward the center is typical of this late devitalization lesion. It is located opposite the cervix region, may appear from 2 to several years after the irradiation and yields readily to treatment.

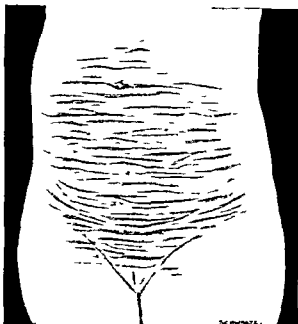


Fig 2 Late subcutaneous infiltration of abdominal wall appearing 2 years after irradiation treatment of carcinoma of cervix. Third degree with deep extensive infiltration and marked widespread vascularization of the surface.



Fig 3 The same abdomen as shown in Figure 2, but 5 months later. The devitalization had definitely progressed and there was a small bluish area which appeared to be beginning necrosis.

*Late Complications in Irradiation Treatment of Cancer of Cervix*

—Quitman L. Vucel and Harry S. Crossen



Fig 5 Same patient as in Figure 4. Back view, to show the discoloration of the skin over the sacral area, where there was much infiltration and vascularization, but no sloughing.



Fig 4 Photograph of the same abdomen shown in Figure 3 (ironispect), but 5 years later. An area the size of a hand had sloughed to the subcutaneous tissue. The granulating surfaces of the lax wall had fallen together and united. Microscopic examination of a section removed from the suspicious area on the right side showed no malignancy.

social worker, and it should be emphasized that a good social worker is very important. She sees these ward patients in the clinic and hospital and, after dismissal from the hospital, sees that they return to the cancer clinic at the appointed time. She makes all appointments for X-ray treatments with the Department of Radiology. The Department of Radiology has full charge of the deep X-ray therapy, and works in close co operation with the gynecologist. The gynecologist has full charge of the radium treatment, and makes all radium im-

plantations. The systematic course of irradiation extends over a period of about 3 months. It is usually started with deep X-ray therapy, in order to secure some devitalizing effect on the outlying cancer cells before the stir-up of the radium implantation in the center of the mass. This preliminary X-ray therapy and course of local antiseptic treatment before the radium implantation, is especially important where there is ulceration or papillary formation. Two or 3 weeks after the preliminary roentgenization the patient is hospitalized for the radium treatment.

After accurate implantation of the radium, the bladder and rectum are pushed away by a

very firm packing, in order to permit the maximum radium dosage which can be safely given with the conditions present in that position. The packing is so firm that the patient can not urinate and, on this account and also to keep the bladder empty and away from the radium, a retained catheter is used. The maximum dosage which can be given safely depends largely on how far away the bladder and rectum can be pushed by the packing. This depends on the amount of fixation of these structures by the carcinomatous infiltration, and of course varies in each case. As a rule the infiltration is mainly into the lateral parametrial tissues, with only late involvement of the bladder and rectal walls. At the time of the radium implantation, a careful examination under analgesia is made and a definite decision reached and recorded as to the clinical classification of the case. It is well also to make another bacterial culture at this time. For the radium treatment, the patient ordinarily remains in the hospital about 5 days and after discharge returns to the clinic for check-up examinations. About 8 weeks after the radium treatment the patient is given the second series of deep X-ray.

This 3 months course of treatment comprises the regular course. Additional X-ray or radium treatment is given only on special indication. After the 3 months' course the patient returns for check-up examination

about every 2 months the first and second years, every 3 months the third year, every 4 months the fourth year every 6 months the fifth year and once a year after that. Of course if there is any local disturbance between times the patient is to come at once.

#### CONCLUSIONS

In the intensive irradiation treatment of 371 patients with carcinoma of the cervix, most of them advanced, we have encountered the following late complications:

Rectal stricture 3 cases, mostly mild and all yielding satisfactorily to dilatation treatment.

Bladder ulceration 4 cases, all responding to irrigations and instillations, and only 1 requiring fulguration to stop bleeding.

Sloughing of the skin 1 case of extensive sloughing with subsequent healing. There was also 1 case of subcutaneous infiltration (first

degree) which seemed stationary, and 1 case of subcutaneous infiltration with superficial vascular change (second degree) which was definitely progressive.

Of course some mild rectal strictures and lesser grades of subcutaneous infiltration may have escaped observation, but the more serious lesions are not likely to be missed. We feel that we have been very fortunate to have accomplished so much in this disease with so few serious complications. This applies both to the radium and the X-ray therapy. The radiologist Dr. Sherwood Moore, has succeeded in giving massive doses of X-ray which aided materially in curing patients and in giving temporary relief to others, with very few of the serious late effects. However, we are always seeking improvements and one of the problems of the day is the difficult task of diminishing still further the incidence of such complications.



# THE CAUSE OF DEATH DUE TO LIVER AUTOLYSIS

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The results of these experiments do not agree with the findings of Andrews and Hidma (1) who state "The influence of diet was then studied by using herbivorous animals and the liver of 1 rabbit was planted into 5 other rabbits and exactly the same clinical picture of autolytic peritonitis was produced."

**Dog 1** Female, weight 24 pounds Preliminary preparation consisted in a high carbohydrate, low protein diet for 3 weeks. At 8:00 p.m., nembutal 3.4 cubic centimeters (1 gram per cubic centimeter) was given. At 8:45 p.m., this was supplemented with ether and 30 grams of liver was removed and placed high in the abdominal cavity. At 10:00 p.m., the condition was good. At 7:45 a.m., the animal was dead, 10 hours after operation.

**Dog 2** Female High carbohydrate, low protein diet was given for 5 weeks and 3 days. At 9:30 p.m., ether and anesthesia was administered, and 46.75 grams of liver was sectioned and placed in the abdomen. At 10:00 p.m., the dog was in good condition. At 11:10 a.m., the animal was dead, 13 hours, 40 minutes after operation.

These two dogs, fed on a high carbohydrate diet, showed no additional resistance, they lived, only 10 hours and 13 hours 40 minutes, respectively, following the operation. These are probably the most sudden deaths we have recorded.

**Rabbit 1** Female, weight 8.25 pounds Nembutal 1 cubic centimeter (1 gram per cubic centimeter) was used. October 23, 8:40 p.m. under aseptic conditions 16.5 grams of liver was removed from a second rabbit and placed high in the abdominal cavity. October 24, animal had quiet day. Water consumption in 24 hours was 500 cubic centimeters. October 25, 8:30 a.m., animal was very active and alert. November 6 (14 days after operation), weight 8.25 pounds. The rabbit was killed and postmortem examination was made.

**Rabbit 2** Female, weight 7.25 pounds. The procedure the same as for rabbit 1 was used. October 27, 19 grams of liver including the gall bladder placed in the abdominal cavity. October 28, animal quiet but alert. October 29, animal was alert and active. November 6, 10 days after operation, animal weighed 6.75 pounds. It was killed and a postmortem examination was made.

**Rabbit 3** Male, weight 7.5 pounds. Same procedure as in previous experiments was used. November 4, 42 grams of liver was placed in the abdominal cavity. November 6, animal was alert, active, and taking food and water. November 6, 56 hours after operation, animal weighed 7.5 pounds. It was killed and postmortem examination was made.

**Rabbit 4** Female, weight 7.5 pounds. Same procedure as for rabbit 1 was used. At 10:00 a.m., 21 grams of fresh dog liver was placed into the abdomen. At 5:15 p.m., breathing was labored and rabbit was



Fig 1 Rabbit liver tissue undergoing aseptic autolysis

very listless. It was found dead the next morning.

*Rabbit 6* Weight 8.25 pounds. The same anesthesia was used as in previous experiments. At 10:25 a.m. 29 grams of fresh dog liver was placed in the abdomen. At 5:15 p.m. the rabbit was alert and appeared well. It was found dead the next morning.

*Rabbit 7* Weight 8.25 pounds. The same anesthesia as formerly was used. At 10:15 a.m. 18.25 grams of fresh dog liver was placed in the abdomen. At 1:15 the animal was sitting up and was alert. At 5:15 p.m. animal was apparently well. It was found dead the next morning.

*Dog 3* Male Weight 33 pounds. Nembutal and ether anesthesia was used. At 7:30 p.m. 73 grams of liver was removed from a rabbit while it was alive and placed into the abdomen of the dog. At 8:45 a.m., the dog was standing. It drank much fluid during the day, the intake being approximately 1210 cubic centimeters above the output. At 7:00 a.m. (second day) the dog was found dead. Death occurred about 30 hours after operation. At 9:30 a.m. postmortem examination revealed the usual findings with 300 cubic centimeters of fluid in the abdominal cavity.

#### THE RELATIVE TOXICITY OF IMPLANTED CENTRAL AND PERIPHERAL LIVER TISSUE

Desiring to obtain additional support for our original observation, in which we found that rabbits survived the operation we extended our series to include 3 more rabbits. However, in order to use fewer animals we removed the entire liver of 1 rabbit and divided it into three approximately equal portions. One piece was then placed into the abdomen of each of 3 animals with the following results:

*Rabbit 8* Weight 8.25 pounds. At 10:30 a.m., 37.5 grams of liver was inserted. At 7:50 a.m., the next day, the animal died.

*Rabbit 9* Weight 6 pounds. The animal died the morning after 38 grams of liver had been inserted.

*Rabbit 10* Weight 7.25 pounds. The animal died the morning after 41.5 grams of liver had been inserted.



Fig 2 Rabbit liver tissue undergoing aseptic autolysis. Greater magnification than used in Figure 1.

These findings are contrary to our original observation and therefore agree with those reported by Andrews and Hrdina (1). It will also be noted that our technique in this series of rabbits was the same as that employed by Andrews and Hrdina, that is, introducing the entire liver of one animal into the abdomen of several other animals. Analysis of these results suggested to us that the only difference in the procedure used in the surviving animals and those that died, was the difference in the location from which the implanted liver was selected. In the former animals we introduced liver sectioned from the periphery while in the latter the sectioned liver included the central portion.

The following experiment illustrates the fact that implanted liver taken from the peripheral portion is less toxic than that taken from the central portion.

*Rabbit 11* Weight 8.25 pounds. At 8:15 p.m., 15.9 grams of liver (peripheral portion) removed from a second rabbit and implanted. At 12:00 noon, the following day, rabbit was quite active and remained in good condition. It was killed 67 hours following operation and postmortem examination was made.

*Rabbit 12* Weight 7.25 pounds. At 8:30 p.m., 15.9 grams of liver (central portion) was removed.

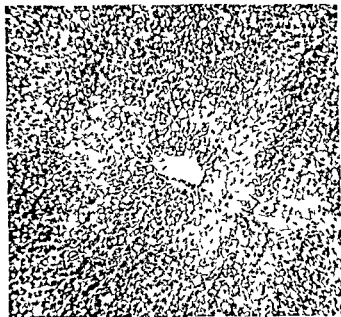


Fig 3a The host's liver (rabbit) accompanying the presence of aseptic autolysis

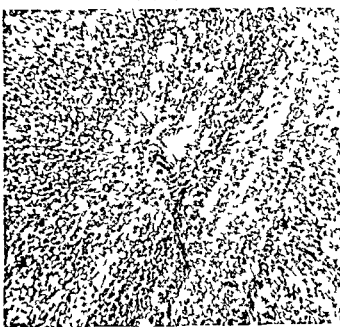


Fig 3b The host's liver (rabbit) accompanying aseptic autolysis

from a second rabbit and implanted. At 8 15 a m, the following day, condition was good. At 10 30 a m, animal died suddenly. Condition appeared good 10 minutes before death. Postmortem examination was made.

#### A STUDY OF THE HISTOLOGICAL AND BACTERIOLOGICAL CHANGES

The animals which survived the operation, that is, those which received peripheral liver

tissue, were subsequently killed and an autopsy performed. The examination revealed a postmortem condition quite different from

that which we have previously found (4) in the non surviving animals. The implanted

liver is firmly adherent to a loop of bowel, it is creamy-green in color, contains no gas and

no odor. Occasionally, there is present only a small amount of free fluid in the peritoneal

cavity. The sectioned liver shows a marked loss of weight is the result of phagocytic ac-

tion and is well illustrated in the microscopic sections.

Figure 1 is an enlarged photograph of a par-

affin section of liver tissue undergoing aseptic autolysis. It will be noted that the invading

phagocytic cells are arranged in a dense formation producing a definite line below the

liver capsule

Figure 2 is a photomicrograph of the section in Figure 1 and shows the process more in

detail.

While the autolysis illustrated is taking place in the implanted liver, the hosts' organs

are also definitely damaged. Accompanying such damage the animals showed definite

toxic symptoms.

Sections of the host's liver and kidney are presented in Figures 3a and b and Figure 4

Dr. L. A. Turley of the Department of Pathology gives the following description of the

liver and kidney. This description is confined to tissue obtained by killing the rabbits ten

days postoperative.

*Liver* "Cords of central and middle zones

of the lobules show rarefaction so marked that the nuclei of the cells appear to be held in

place by a lace-like web. The cells of the peripheral zones have a fine, foamy appearance. The tissues of the portal canals are

infiltrated with lymphocytes, endothelial cells, and an occasional polymorphonuclear leucocyte. This infiltration is most marked around the bile ducts. This liver is the victim of what

appears to be a rather acute and marked fatty degeneration plus a septic cholangitis." *Kidney* "The lesions in the kidney vary with the different fields. In some fields the

capillaries of the tufts and tubules are en-



Fig 1 Rabbit liver tissue undergoing aseptic autolysis

very listless. It was found dead the next morning.

*Rabbit 6* Weight 8.25 pounds. The same anæsthesia was used as in previous experiments. At 10:25 a.m. 29 grams of fresh dog liver was placed in the abdomen. At 5:15 p.m. the rabbit was alert and appeared well. It was found dead the next morning.

*Rabbit 7* Weight 8.25 pounds. The same anæsthesia as formerly was used. At 10:15 a.m. 18.25 grams of fresh dog liver was placed in the abdomen. At 1:15 the animal was sitting up and was alert. At 5:15 p.m. animal was apparently well. It was found dead the next morning.

*Dog 3* Male Weight 33 pounds. Nembutal and ether anæsthesia was used. At 7:30 p.m. 73 grams of liver was removed from a rabbit while it was alive and placed into the abdomen of the dog. At 8:45 a.m. the dog was standing. It drank much fluid during the day, the intake being approximately 1210 cubic centimeters above the output. At 7:00 a.m. (second day) the dog was found dead. Death occurred about 30 hours after operation. At 9:30 a.m. postmortem examination revealed the usual findings with 300 cubic centimeters of fluid in the abdominal cavity.

#### THE RELATIVE TOXICITY OF IMPLANTED CENTRAL AND PERIPHERAL LIVER TISSUE

Desiring to obtain additional support for our original observation in which we found that rabbits survived the operation, we extended our series to include 3 more rabbits. However, in order to use fewer animals we removed the entire liver of 1 rabbit and divided it into three approximately equal portions. One piece was then placed into the abdomen of each of 3 animals with the following results.

*Rabbit 8* Weight 8.25 pounds. At 10:30 a.m. 37.5 grams of liver was inserted. At 7:50 a.m. the next day, the animal died.

*Rabbit 9* Weight 6 pounds. The animal died the morning after 38 grams of liver had been inserted.

*Rabbit 10* Weight 7.25 pounds. The animal died the morning after 41.5 grams of liver had been inserted.



Fig 2 Rabbit liver tissue undergoing aseptic autolysis. Greater magnification than used in Figure 1.

These findings are contrary to our original observation and therefore agree with those reported by Andrews and Hrdina (1). It will also be noted that our technique in this series of rabbits was the same as that employed by Andrews and Hrdina, that is, introducing the entire liver of one animal into the abdomen of several other animals. Analysis of these results suggested to us that the only difference in the procedure used in the surviving animals and those that died, was the difference in the location from which the implanted liver was selected. In the former animals we introduced liver sectioned from the periphery while in the latter the sectioned liver included the central portion.

The following experiment illustrates the fact that implanted liver taken from the peripheral portion is less toxic than that taken from the central portion.

*Rabbit 11* Weight 8.25 pounds. At 8:15 p.m. 15.9 grams of liver (peripheral portion) removed from a second rabbit and implanted. At 12:00 noon, the following day, rabbit was quite active and remained in good condition. It was killed 67 hours following operation and postmortem examination was made.

*Rabbit 12* Weight 7.25 pounds. At 8:30 p.m. 15.9 grams of liver (central portion) was removed

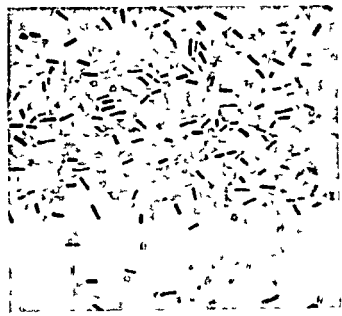


Fig. 6 Organism obtained from central portion of rabbit liver

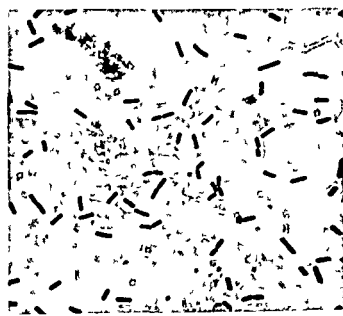


Fig. 7 Impression smear of the liver from incubated rabbit 13

into each of rabbits 13 and 14. After 5 minutes rabbit 13 was killed and placed in an incubator for 22 hours. Autopsy at this time showed the following. The liver was soft and friable with a consistency that of soft cottage cheese. All the tissues were crepitant. The striated muscle was riddled and the odor was very foul. Impression smears were made and stained by the Gram's method which showed enormous numbers of positive rods identical with those found in the autolyzed liver of rabbit 12. *Rabbit 14* Was permitted to live and showed no ill effects from the injection.

Figure 6 is a photomicrograph of the organism which was obtained from the culture of the central portion of liver, part of which was implanted in rabbit 12. The peripheral portion of the same liver and that which was introduced into rabbit 11 on culture showed no anaerobic organisms.

Figure 7 was obtained as an impression smear from rabbit 13. The source of the organism was the same as that reported in

DEDUCTIONS

Sectioned liver tissue undergoing aseptic autolysis within the abdomen is accompanied by definite damage to the host. This is evidenced by changes in liver and kidney of host and also by toxic symptoms manifested in all of our previous reports on this subject, the experimental data were obtained from dogs. Therefore when the first 3 rabbits of this series survived the operation, we were of

the opinion that the survival was due to the type of diet selected by the rabbit. This conclusion also agreed with the observation of Salzmänn who found that rats either survived the operation or died depending entirely upon the type of diet fed the animals. Continuing our experiments we have been forced to conclude that all the surviving animals received implanted liver tissue sectioned from the periphery of the liver. Such tissue proved to be free of the anaerobic bacillus. We further observed that the implanted liver tissue sectioned from the central portion caused death and also gave a positive culture for the organism. It has been observed by Andrews et al (1) and also by Dvorak that this organism may be injected in large amounts into the peritoneal cavity without causing the death of the animal. We have injected the organism intravenously and found it affected the animals but little, if at all. However, if shortly after such an injection we killed and incubated the animal, we subsequently found the tissues completely riddled by the organism, the liver being destroyed.

The sequence of events which leads to the death of the animals appears to be as follows. The bacteria remain in a latent state until stimulated to activity by the asphyxiation of the liver tissue. The activity of the bacteria then accelerates the production of toxic prod-

ucts and these, in turn, cause death by producing a chemical reaction. The picture is not that which we usually consider as a generalized peritonitis but the bacteria confine their activity locally to the selected substrate. Also the rapidity with which death follows the operation after 10 to 15 hours is not in keeping with the usual picture of peritonitis. The damage to the tissues of the host shown in the microscopic sections with and without the presence of bacteria rather suggests that the process which produces death is not necessarily a difference in kind but rather a difference in degree, the action of the bacteria only accelerating the liberation of toxins from the liver tissue. Trusler and Reeves have demonstrated the fact that the organism does not produce exotoxins and it has also been shown that the organism may be cultured within the abdomen substrates other than adult liver tissue being used without causing death (3).

#### CONCLUSIONS

1. Additional evidence is submitted to support the contention that the absorption of dead and autolyzed tissue is associated with toxic symptoms on the part of the host.

2. Death is not due to a generalized peritonitis but rather to the absorption of toxic products generated from the liver tissue deprived of its circulation.

3. The anaerobic bacillus found at the time of death may be injected intraperitoneally and intravenously without causing any harmful results.

We wish to express our appreciation for the assistance given us by Miss Ida Lucille Brown of the Department of Bacteriology.

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THE HISTOLOGY OF THE BILIARY DUCTS AND ITS CORRELATION WITH THE SYMPTOMATOLOGY OF COMMON DUCT STONE<sup>1</sup>

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**S**TANDARD works of reference in medicine and surgery enumerate a remarkably uniform list of symptoms said to be caused by the presence of calculi in the extrahepatic biliary passages. In the past several years, the "asymptomatic common duct stone" has been the theme of several writers (3, 6), but nevertheless the gathered opinions of members from several surgical staffs gave the impression that biliary colic is the chief signpost to a diagnosis of calculus in the common duct. In direct variance with this is a statement by Professor D P D Willie, of Edinburgh, that common duct stone never gives rise to colic, since that section of the biliary tract exhibits in its wall no muscular tissue, and is therefore non contractile, non-peristaltic. Attacks of biliary colic, while stated, are produced only by the passage of a stone along the cystic duct with its regular layers of musculature. This assertion seemed sufficiently novel to merit investigation, and it proved would obviously be of great diagnostic importance. The subject has been pursued along three lines.

Duncan and Keir, in 1900, remarked that jaundice may be absent in common duct stones, and in Jordan's series of 106 operations for this condition 10.6 per cent of the patients were without jaundice. Oertel described a case in which complete common duct obstruction by stone had been compensated for by saccular dilations of the ducts to such an extent that the patient died without jaundice. Mann's experiments verified this possibility in animals, where dilatation of the ducts delayed the onset of jaundice. Clute reported that 37 per cent of his operative cases with common duct stone showed no jaundice. He recommended more frequent cholecystectomy when having found stones in the common duct in 18 per cent of his cases in a 3 year period due to this procedure. He remarked that a slight elevation of blood bilirubin often means common duct stone. A further series of cases reported by Klingenstein showed 6 per cent without jaundice, and a slightly smaller percentage without colic.

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account for causation of biliary colic are many and varied. Such are concerned with impaction of a calculus in the ampulla of Vater, distortion of the ducts, and the size and shape of the obstructing stone. The cases to be quoted below will suggest the futility of such explanations. Kellerson and McNee are authorities for the statement that severe biliary colic may be present in the absence of any calculi, being due to cholecystitis with inflammatory reaction in the sensitive subperitoneal tissues. Most commonly accepted is the view that colic is due to spasm of the

obstruction which has since been associated with his name. Kehr, in 1900, remarked that jaundice may be absent in common duct stones, and in Jopdan's series of 106 operations for this condition 10.6 per cent of the patients were without jaundice. Oertel described a case in which complete common duct obstruction by stone had been compensated for by accessory dilatations of the ducts to such an extent that the patient died without jaundice. Mann's experiments verified this possibility in animals, where dilatation of the ducts delayed the onset of jaundice. Clute reported that 31 per cent of his operative cases with common duct stone showed no jaundice. He recommended more frequent cholecystectomy when having found stones in the common duct in 18 per cent of his cases in a 3 year period due to this procedure. He remarked that a slight elevation of blood bilirubin often means common duct stone. A further series of cases reported by Klingenstein showed 6 per cent without jaundice, and a slightly smaller percentage without colic.

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Fig. 1. Low power field from an area in a longitudinal section of the common bile duct 2 millimeters distal to the sphincter of Oddi. Shows scattered muscle fibers usually lying individually among fibrous and elastic tissue. At the lower edge are seen a few organized muscular strands tailing off from the sphincteric muscle. Phosphotungstic acid stain.

and recent. For example a large volume of *Special Histology* published in 1928 (10), states that in the cystic duct exist three directional smooth muscle fibers while in common and hepatic ducts only very small amounts are present and without definite layers. Maxwell emphasizes the fact that only the common duct shows bundles of smooth muscle running in oblique and longitudinal directions forming an incomplete layer around the duct. Burden observed that the hepatic cystic and common bile ducts are identical in structure there being bundles of unstriated muscle lying in the outer layer of areolar tissue together with blood vessels and lymphatics. He claimed that these muscle bundles were well developed and formed isolated longitudinal and circular layers thus producing a loose network rather than a compact layer. Rolleston and McVee make the bald statement that the bile ducts are without muscular tissue at any point but quote no proof of such statement. In spite of the fact that nearly all possible combinations seemed to have been exhausted by these various authorities it was proposed to prove, if possible, which of the statements here quoted was correct.

Microscopic sections were first made from the various parts of the bile duct—hepatic cystic and common. Three stains were employed: hematoxylin and eosin, phosphotungstic acid stain for muscle, and Weigert's for elastic tissue. As no muscular coats could be found in the bile ducts in the material examined from the first few autopsies, a more systematic method was followed.

The gall bladder and the cystic and common ducts down to the entrance of the latter into the duodenum and including a section of the duodenal wall, were removed from cadavers showing no gross evidence of biliary tract infection. After being washed in water the preparation was injected through the ampulla of Vater with Zenker's solution until the ducts were moderately distended. When sufficiently fixed, sections were taken at regular levels, as follows:

- A Through sphincter of Oddi and along the terminal portion of the common duct
- B From proximal portion of common duct
- C From distal end of cystic duct
- D From proximal portion of cystic duct
- L Through the junction of cystic duct with the neck of the gall bladder

These sections were then stained with phosphotungstic acid which, after study of numerous sections was determined to be the best stain for the detection of muscle tissue. In all 84 sections some transverse but most of them longitudinal were prepared from the material obtained from 14 autopsies.

A study of these sections shows that the muscular coats as such cease very abruptly at the neck of the gall bladder sometimes with a sphincter like structure at the origin of the cystic duct. The remainder of the biliary ducts common cystic and hepatic are merely fibro-elastic tubes lined with a high columnar mucosa, covered by a serosal layer with the usual subserosal areolar tissue. Only small isolated fibers of unstriated muscle are present sometimes indistinguishable from connective tissue cells. In many sections a search of several high power fields is necessary to demonstrate even isolated muscle cells. A striking point in the study of many of these ducts is the presence of comparatively large glands in the duct walls, as described by Burden. It is a



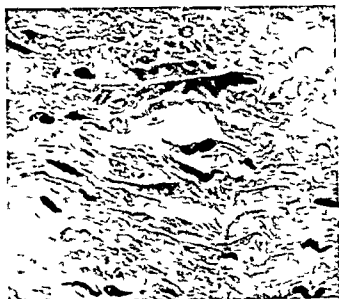


Fig. 2 High power view of a field from Figure 1. Individual muscle fibers stand out in contrast to connective tissue

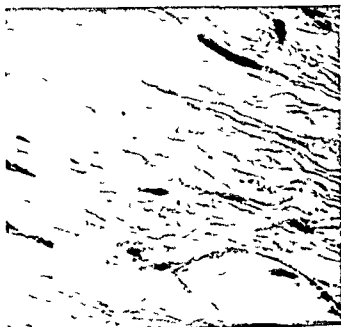


Fig. 3 High power view of an area several low power fields distal to that in Figure 1. Note marked decrease in number of muscle fibers. Phosphotungstic acid stain

these findings for the two series of cases is presented in Tables I and II. In Table III is shown the percentage incidence of these signs and symptoms in the combined series. Certain points are of interest even in this small series. Jaundice is the one near constant sign, yet one woman with a 3 year history and as many calculi in the common duct failed to show an icteroid tinge at any time, although the icteric index was 13.7. Next in order is a high percentage with history of digestive upset, or chronic upper abdominal pain, or both, over a period of years, or at least months. *There was frequently acute exacerbation of such symptoms when the calculi presumably entered the biliary ducts, as shown by 81 per cent of the quoted cases.* Much of this is due, of course, to activation of chronic cholecystic disease, but a perusal of these clinical histories leads one to believe that any individual who suffers, in mid or late life, a sudden up-trend in severity of previous cholecystic symptoms is an eligible candidate for the diagnosis of common duct stone. If this be associated with icterus and its accompanying manifestations, or failing that an elevated blood bilirubin, or with a dull, radiating, upper abdominal pain, or with chills or fever, the diagnosis becomes more than probable.

The histories were examined as to 6 cardinal points: (1) chronic indigestion (i.e., painful attacks), with headaches, and so called "bilious digestion", flatulence, and (2) dull pain in upper abdomen with radiation posteriorly, (3) well defined biliary colic, (4) presence of jaundice, (5) chills, (6) fever. The relative frequency of

of elective cases in other clinics due in part, of course, to the greater number and 90,000 (L.A.C.G.H.). This variation is hospital populations of over 30,000 (T.G.H.) seems to indicate an extraordinarily low incidence of calculous cholecystic disease among 10 years, Mayo-Robson 380 in 10 years) this or autopsy. When contrasted with the figures removed from the common duct at operation (1927-32) in which stone had actually been 8 at the Los Angeles County General Hospital the Toronto General Hospital (1926-31), and number of cases in the 5 year period to 16 at culi in the common duct. This reduced the those cases definitely proved to have had cal-

3 The clinical review was confined to tubed in the outer part of the wall. present in great abundance, usually dis- for low grade cholangitis. Nerve fibers are to organisms metastatic from other foci of infection, and subsequently become responsible real possibility that these glands offer lodging

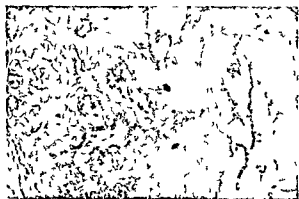


Fig 4 Low power view of an area from the mid portion of the common bile duct. Virtual absence of muscle fibers. Large groups of hyperplastic glands in duct wall, some of which are cystic and dilated. Hematoxylin-eosin stain.

Most unusual in this series is the extraordinarily low incidence of biliary colic. With the appearance of colic the difficulties of diagnosis are largely erased, but 56 per cent of these cases failed to present such conclusive evidence of common duct stone. In none of the 8 autopsy cases in which the pathologist was the final arbiter was the symptom of colic found in the medical history. This is certain indication of the reluctance with which a diagnosis of biliary duct calculus is surveyed without the *sine qua non* of colic.

Chills were a feature in 7 instances (26 per cent) and fever in 8 (29 per cent).

It should be mentioned that the dull upper abdominal pain complained of by some of these patients is by no means confined to the right upper quadrant. At least 4 (14 per cent) reported left upper quadrant pain, and 3 epigastric pain. Two of the former patients had their radiation of pain to the left scapula.

Only 1 of the 27 cases presented all of the 6 cardinal features herein tabulated, and a second 5. Ten or 37 per cent, had 4 out of the 6 signs or symptoms, and 6 (22 per cent) only 3. Seven others had only jaundice and one other point, while 1 case presented only jaundice. In the aged, common duct stone, like acute appendicitis, seems remarkable for the lack of clinical evidence produced. Especially is this true of the colic symptom, only patient in this series over 60 presenting this evidence.

Clute's advice regarding more frequent opening of the common duct during operative



Fig 5 Low power photomicrograph of an area from the mid portion of a cystic duct. There is complete absence of muscle fibers. Phosphotungstic acid stain.

procedures for cholelithiasis seems to be borne out in this series. Nine of the quoted cases had had previous cholecystectomies or cholecystotomies, and several operative reports stated the bile ducts to be without exterior evidence of calculi. In experienced hands the mortality cannot be appreciably raised by the additional technique and time involved. There is certainly adequate compensation, even if convalescence is lengthened by duct drainage, in the knowledge of a certain result. The formation of calculi in the intrahepatic ducts, as described by Judd and Burden, is of great rarity.

Certain cases of this series merit special remark, inasmuch as they illustrate the futility of attempting any reasonable explanation of pain production.

M. C., female, 40 years old, suffering severe colic, was found at operation to have the largest solitary stone in the series, 3 by 1.5 centimeters in the common duct. It has been said that small stones produce most severe colic. In this instance, at least a large stone produced severe colic.

J. F., aged 57 years, had had a cholecystectomy in 1923 and was admitted in 1928 with jaundice, fever, and chills. He was without pain or colic, and the autopsy showed a calculus of bean size impacted in the ampulla of Vater, and behind it several smaller stones. The ducts were distended to several times normal diameter throughout. In brief, this individual had failed to develop colic or pain in spite of impaction of a stone in the ampulla, the presence of several small stones and distention of the ducts—all of which conditions have been named at one time or another as causative of colic.

TABLE I—PROVED COMMON DUCT STONE

Cases at Los Angeles County General Hospital, 1947-1952

Case	Age	Sex	C I	Radiation	Colic	Chills	Fever	Jaundice
M C 1498	46	M	+	+	+	+	+	+
R C 1477 6	50	F	+	+	+	+	+	+
W E R 15184	64	M	+	+	+	+	+	+
E M 66 765	43	F	+	+	+	+	+	+
E I 178 550	44	F	+	+	+	+	+	+
J M 128 649	40	M	+	+	+	+	+	+
J B 5 912	47	F	+	+	+	+	+	+
J W 90 768	42	M	+	+	+	+	+	+
J M 124 712	60	M	+	+	+	+	+	+
J H 36 260	77	F	+	+	+	+	+	+
M V 10 721	43	F	+	+	+	+	+	+

Key: C I—Chronic indigestion, no bile duct etc. Radiation—Bill pain with radiation

J L was a man of 70 years, who had suffered from duodenal ulcer for 10 years, but never from colic. In hospital he had a moderate increase of the pain with intermittent chills, fever, and jaundice. Autopsy showed a marble sized stone occluding the ampulla of Vater, with several others in the duct. In the liver were multiple abscesses. Again no colic in spite of multiple stones and occlusion.

M D, a woman 70 years of age, presented increasing jaundice for 4 months. After admission to hospital her empyemic gall bladder was drained. Autopsy proved the common duct to contain 13 stones of various size. All the hepatic ducts were dilated. She had never suffered even dull pain, nausea, vomiting, and headaches were the only symptoms. Here multiple stones and dilatation of extrahepatic ducts failed to produce pain.

K C was a man of 70 years, whom autopsy showed to have a carcinoma of the gall bladder with complete occlusion of the cystic duct by carcinoma. months' standing which was found at autopsy to be quite patent, and with the remainder of the biliary tree free from carcinoma invasion. This stone must therefore have been present for many weeks in the common duct (i.e., before the cystic duct became occluded by carcinoma), and was probably responsible for the marked jaundice. His only pain had been epigastric, and of very moderate severity, generally following meals. Thus, in spite of a calculus obstructing the common duct for many weeks—probably 3 months—this individual had never exhibited anything approaching a colic like pain.

Illustrating the necessity of common duct exploration in doubtful instances is the case of W L R, a 64 year old male.

Cases at Toronto General Hospital, 1926-1931

Case	Age	Sex	C I	Radiation	Colic	Chills	Fever	Jaundice
B 01500	66	F	+	+	+	+	+	+
J M 01673	53	M	+	+	+	+	+	+
D C 09174	42	F	+	+	+	+	+	+
I M 01774	40	F	+	+	+	+	+	+
F B 02764	55	M	+	+	+	+	+	+
M C 02445	40	F	+	+	+	+	+	+
O M 02594	53	M	+	+	+	+	+	+
K M 02708	43	F	+	+	+	+	+	+
M C 02081	65	F	+	+	+	+	+	+
L K 04967	57	F	+	+	+	+	+	+
S M 03273	51	M	+	+	+	+	+	+
J E 02568	70	M	+	+	+	+	+	+
N D 01044	70	F	+	+	+	+	+	+
M R 01368	50	M	+	+	+	+	+	+
F C 04708	70	M	+	+	+	+	+	+
M T 05181	71	F	+	+	+	+	+	+

TABLE III

Cases	Total cases of common duct stone	Female	Male	Average age	Chronic indigestion	Biliary colic	Bill pain with radiation	Jaundice	Fever
55	50	27	23	55	22	24	44	44	20

Ten years before the last admission a cholecystectomy had been performed, and this was followed by jaundice. During the following years he suffered from recurring indigestion and occasional dull epigastric pain. Before admission he developed a constant dull epigastric pain, and pain in the right upper quadrant without radiation, followed by a gradually developing jaundice. In hospital, a pre-operative diagnosis of catarrhal jaundice or "adhesive" was made, and the occasional chills he complained of laid to "biliary system." The jaundice cleared, the abdomen was opened, and gastro-enterostomy was done because of dense, distorting adhesions about the pylorus. The biliary ducts were not exposed. After a postoperative death, an obstructing calculus was found at autopsy in the common bile duct.

The same point is illustrated by another case.

E M, a 43 year old woman who 3 years before admission had been operated upon for empyema of the gall bladder. At that time a number of stones were

removed from the gall bladder and the gall bladder drained. She continued to have chronic right upper quadrant pain and flatulence for the 3 years, but no colic at any time. Eventually the common duct was explored and found to contain 3 large stones, and the duct itself was much thickened and dilated.

I W, a male aged 70 years, illustrates the case with atypical distribution of pain. Having had a cholecystectomy 13 years previously, his chief complaint on admission was left upper quadrant pain radiating to the left scapula. As he presented a marked jaundice and had constant chills and fever, the common duct was explored and a solitary stone  $\frac{3}{4}$  centimeter in diameter removed.

#### SUMMARY

1 Material has been examined to show that the biliary ducts possess throughout only small isolated fibers of muscle irregularly scattered. The bile ducts are fibro elastic tubes richly supplied with nerve fibers, lined by tall columnar epithelium and frequently featured by the presence of large subepithelial glands lying in the membrana propria, singly and in groups.

2 Biliary colic is not caused by muscular spasm according to these histological findings. Several quoted cases go to show that most of the other theories usually advanced as etiological factors of pain are probably false.

3 Colic is by no means a constant symptom of calculi in the bile passages as shown

by an absence of that symptom in 56 per cent of 27 cases presented.

4 The most frequent symptom of common duct stone is an exacerbation of previous indigestion, flatulence, or dull upper abdominal pain with or without radiation. The one near constant finding is jaundice.

5 A survey of this series impresses one with the need of more frequent exploration of the common duct as a combined procedure with cholecystectomy for cholelithiasis.

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# THE BLEEDING TENDENCY IN JAUNDICE

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THE surgical and medical risks of infection and about the liver are seriously augmented by the possibility of hepatic insufficiency. One of the most striking surgical features associated with these cases of liver damage is their tendency to bleed. According to the results obtained in several clinics, 50 per cent of all postoperative deaths in patients with jaundice or liver insufficiency are a result of hemorrhage (8, 25, 26, 36). The following study was undertaken chiefly in an effort to reduce these operative risks.

## DETERMINATION OF BLEEDING TENDENCY

The first objective was to devise a reliable clinical method that would disclose the latent hemorrhagic tendency in jaundiced patients. The great variability of bleeding tendency in jaundice is well known. Jaundiced patients with a normal Duke's bleeding time, normal coagulation time, and normal blood coagulating factors will frequently bleed abnormally, and patients with abnormal findings will frequently not bleed. Many clinical and laboratory methods have been recommended to determine the existence of a bleeding tendency, but none of them so far has been an accurate guide. As Colbeck has stated, there is no definite method as yet for the evaluation of the bleeding tendency in jaundice.

*Blood coagulation factors.* *In vivo* studies of the various blood coagulation factors in jaundice have been extensive. Analysis of the literature forces the conclusion that although there are variations in these factors, these variations cannot be correlated reliably with the bleeding tendency. Changes in blood calcium, albumen, platelets, prothrombin, antithrombin sedimentation rate, etc., are observed just as frequently without as with a but-morrhagic diathesis in jaundice.

*Calcium.* There is undoubtedly a disturbed calcium metabolism in jaundice, such as altered calcium balance, osteoporosis, etc.

As one of us (A. C. I., 14) has already pointed out, the literature does not agree on the relation between this disturbance of calcium and the hemorrhagic diathesis found in some cases. Blood calcium levels, both fixed and diffusible, are unchanged or only slightly changed in jaundice. The general weight of experimental evidence seems to uphold the view that although a functional deficiency of calcium exists, it has no relation to the bleeding tendency (Linton, 22, Snell and Greene, Gunther and Greenberg, Ivy, Wangenstein, Colbeck).

It is true that in jaundice intravenous calcium improves coagulation *in vitro*, but the mechanism by which it does so is not clear. Furthermore, extravascular clotting has little relation to bleeding tendency. Following the lead of Mayo-Robson, Wright and Paramore, Lee and Vincent, Walters (34), Whipple, Judd, and others, the pre-operative administration of calcium is widely used (Cantarrow, McKnight Web, Brennan, Hanlon, Sistrunk, and others). But failures are frequent. As Wangenstein and also Colbeck have summed up intra-venous calcium has not solved the problem of hemorrhage in jaundice.

Blood calcium determinations, therefore, are of no value in determining the bleeding tendency. The problem of diffusible calcium presented itself, however, and was studied in many of our cases. The results will be set forth in a separate communication.

*Other blood coagulation factors.* Bancroft, Kugelmass and Stanley-Brown in a study of 200 surgical cases concluded that no one factor can be isolated as a cause of bleeding or clotting. They devised a "clotting index" calculated from the prothrombin content, albumen content of the prothrombin content, fibrinogen content of platelet count, degree of platelet lysis, and antithrombin. In later studies, they dropped the platelet count and lysis studies, because these could not be correlated with clinical bleeding. Another inter-

esting conclusion was that the clotting tendency can be determined reliably after operation, but not before because when a latent bleeding tendency exists, the ether damage to the liver and operative shock make it manifest.

For clinical use such a clotting index is entirely too elaborate (Mills, and Clute and Veal). But of greater importance, it is probably inaccurate. The attempt to study the bleeding tendency by splitting it into many factors is misleading. One factor after another is heralded as the important one, only to be dropped when found to be clinically unreliable. For in any given case one factor may compensate for another both in the calculation and clinically. In different bleeding conditions different factors are involved. Furthermore, when all factors are normal the patient may still bleed because he may be on the threshold of bleeding and ether, acidosis, operative shock, etc. may push him over this threshold. *It seems as if the only way at present to determine a bleeding tendency is to see if the patient bleeds.* Yet, such a posteriori determinations would be of no value in preparing patients for operation.

With particular reference to jaundice the same conclusions apply. Lewisohn found a decrease in prothrombin and fibrinogen and an increase in antiprothrombin associated with increased risk of hemorrhage. Murakami and Yamaguchi found a decrease in fibrin ferment in jaundice. Johnson concluded that in experimental obstructive jaundice clotting was delayed because the quantity and quality of the fibrin seems deficient. But Linton found that in obstructive jaundice there is no deficiency in the blood fibrin, in fact a distinct increase. Moss also found a distinct increase in plasma fibrinogen in experimental obstructive jaundice. Mann and Bollman found after removal of the liver that prothrombin did not change, antithrombin sometimes increased and sometimes decreased, and fibrinogen remained normal for a time, but after depletion did not regenerate. The sedimentation rate has also been suggested as a guide to the bleeding tendency in jaundice. Linton (21) considers it to be an accurate guide. Clute and Veal, however, consider it suggestive and helpful, but not absolute.

As with calcium, after much study, determinations of other blood clotting factors were discarded in the present study as not furnishing a reliable guide.

**2 Coagulation time** Determination of coagulation time is today a most widely used procedure. Yet it seems to have relatively little value. In many hundreds of cases studied by many authors (Kleiner, Hunt, Harter, Feinberg, Bland and Goldstein, Kugelmass, Bancroft and Stanley Brown, and others) the general conclusions are that prolonged clotting time seems to bear no relation to clinical bleeding, and it is often normal in severe blood dyscrasias and when bleeding occurs. The only condition in which a prolonged coagulation time is diagnostic is hemophilia. The multiplicity of methods devised for the determination of clotting time points to the difficulty in their evaluation. No less than 33 different methods (probably more) are known (Solis Cohen). Moreover, the numerous factors affecting the clotting time of shed blood, such as contact with air, glass and dirt, size and shape of drop, amount of blood, mechanical disturbance of blood, evaporation, temperature, dilution, end point adopted, personal equation, part punctured, contact with tissues, skin and lymph, depth and character of the wound, pressure, meteorological factors, age, hemoglobin, food fluid, etc., make the interpretation very difficult. In an exhaustive study of the subject Solis Cohen has analyzed all these points carefully.

In spite of the unreliability of the method it was decided in the present study to investigate the coagulation time. The methods of Bogg, Biffis, Lee and White, and Howell were used. Those of Bogg and Biffis were first done on 115 normal individuals to get a standard. Up to 6 minutes was found normal with the Bogg's method (average range of 3 to 5 minutes) and up to 9 minutes for the Biffis. In 60 cases of jaundice, and in 25 miscellaneous pathological cases, the coagulation time was invariably found to be normal. Lee and White's method was done on 32 cases, and Howell's method on 30 cases. These were all normal.

In only 1 jaundice case was the Bogg's method above normal, 13 minutes. This patient

It was felt that if the factor of capillary tonus could be eliminated and the capillaries kept wide open, the situation would be simplified and a latent bleeding tendency revealed in present. Such a situation is comparable clinically when ether, shock, operative trauma, etc., results in capillary paresis and bleeding. The skin of the forearm near the elbow over the pronator muscles was selected as being uniformly thin without the disturbing factor of differences in hornification present on the finger tips. Ordinary Duke's punctures (with mechanical stylé set a uniform depth of about 2.5 millimeters for all cases) gave the usual bleeding time as 30 seconds to 3 minutes. Heat was then applied and another puncture done. No constant change was noted. Cold was then used, no dependable difference could be noted. *Histamine* (which does not alter blood coagulability, Best and Alfkeny) was then injected intradermally to produce capillary paresis. No constant changes were found. Altogether 80 cases were studied in this manner.

One of us (A. C. I.) then suggested applying the cuff of a sphygmomanometer around the arm, with a pressure of about 100 millimeters of mercury, enough to cut off effectively the venous return. By increasing the pressure in the capillaries and arterioles in this manner, the factor of "capillary tonus" might be eliminated. [This was done, with most gratifying results.]

It was found in a large number of normal individuals (115 cases) that very little difference existed between the Duke method and the modified method with venous pressure readings and an increased volume of bleeding as demonstrated by the total area of the drops on the filter paper. After many trials the upper limit of normal for the venous pressure was rarely over 180 seconds. But, when the method was tried on a number of cases of jaundice, it was found that often, when the Duke's bleeding time was normal, the venous pressure was definitely prolonged. These cases with a prolonged venous pressure bleeding time were almost always found to be the cases that bled, either spontaneously or after

A factor which has received little attention in bleeding studies is the state of "tonicity" of the capillaries. In small vessels it is the retraction of their walls to a large extent which stops bleeding. No other factor can explain the fact that the normal bleeding time of 30 to 180 seconds (Duke) is much less than the normal coagulation time. Von Bernuth and Magnus have demonstrated this clearly, by actual observations of the capillaries with the capillary microscope. Magnus has shown that the normal capillary, when cut, will contract, force out its content of blood, and then disappear completely from view because of its contraction. In a case of hemophilia, von Bernuth found that the capillaries did not contract after being cut, but remained patent and continued to bleed. In a case of Werthof's disease, however, the capillaries reacted in the normal manner. This field offers fascinating possibilities for study, and should be investigated further.

was operated upon and died, but of cholemia, not of hemorrhage. This would seem to indicate that the prolonged coagulation time in jaundice is not so much an index of bleeding tendency as of liver damage. Walters (35) agrees in this view.

Coagulation time, then, was also discarded along with calcium and other determinations as not being an accurate guide.

3. *Bleeding time* In bleeding conditions, the simple fact is that the patient bleeds. The problem is how to demonstrate beforehand that he is going to bleed. Duke's bleeding time is used universally. To a large extent in jaundice it has been disappointing. Here it is of little more value than the coagulation time. True, in severe anemia, febrile states, acute leucemias, and in pronounced hemorrhagic diatheses, in general, it is prolonged, and is the single most reliable method of predicting a bleeding tendency. But a latent bleeding tendency, such as is found in many cases of jaundice, is not revealed by the ordinary puncture of the skin. Thus, it was felt that some way should be found to make a patient with a hypothetical latent bleeding tendency bleed excessively from an ordinary skin puncture, and thus possibly make it manifest.

operation. In the following study of 510 pathological cases this fact was demonstrated repeatedly. We are not prepared to say just what is the mechanism involved (blood chemical studies of diffusible calcium were made and will be reported separately), but we do feel convinced that the method is of distinct value in predicting a hemorrhagic diathesis in jaundice.

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# THE EFFECT OF VIOSTEROL IN JAUNDICE<sup>1</sup>

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THE bleeding tendency in jaundice is undoubtedly related to the degree of liver damage. The mechanism of this relation is obscure, but the clinical facts are obvious. The venous pressure bleeding time, or "Ivy" bleeding time (as we have named it) is, therefore, in a sense, a measure of the degree of liver damage.<sup>2</sup> That this is true is also brought out by a study of other types of liver damage without jaundice. The Ivy bleeding time is prolonged in many cases of cirrhosis of the liver, in cases of chronic cholecystitis with associated liver damage, etc. Cases with liver injury, then, formed the bulk of those selected for study.

Dr R H Jaffe suggested to us that a possible explanation for the bleeding tendency in cases of obstructive jaundice was that because of the decency of bile in the gastro intestinal tract, there was a failure in absorption of fat soluble vitamins, particularly vitamin D. As this work was being completed, a publication appeared from the University of California which confirmed this suggestion. Greaves and Schmidt proved that in the absence of bile from the intestinal tract, little or no vitamin D is absorbed. In non-obstructive jaundices or in any liver decency with a marked decrease in biliary intestinal content, the vitamin D absorption is not completely inhibited but is definitely impaired. The exhibition of large doses of viosterol or the administration of bile salts with it, we thought might correct this deficiency.

The liver stores vitamin D, and apparently utilizes it in its haemostatic functions (1, 4). Many reports have been recently published which demonstrate the profound effect of vitamin D on the various blood coagulating factors (Kugelmass and Samuel, 9; Woeblisch, Shurt and Baum, Lopez, Cramer and Drew, and others). In particular, the effect of vi-

sterol actually would decrease the bleeding tendency of cases of jaundice or hepatic insufficiency. Eight hundred and ten unselected cases at the Cook County Hospital were studied in a period of 14 months. Almost all the jaundiced patients who entered the hospital during this period were studied, namely, those with common duct stone, cirrhosis of the liver with jaundice, toxic hepatitis catarrhal jaundice, primary and metastatic carcinoma of the liver, tenancy in jaundice.

<sup>1</sup>See Ivy A C Shapiro P F and Melnick P The bleeding tendency in jaundice Surg Gynec & Obst 1935 60 181 184  
 This work was aided by a grant from Mead Johnson and Company

carcinoma of the extrahepatic bile ducts and of the head of the pancreas, etc. Another large group included patients with liver damage but without jaundice, such as cirrhosis of the liver without jaundice, chronic cholecystitis, and cholelithiasis, etc. A miscellaneous group of jaundiced patients included pneumonia with jaundice, cardiac decompensation with jaundice, etc. In addition various types of miscellaneous patients were studied, mainly as controls, such as various types of blood dyscrasias and anemias, purpura, tonsil cases with bleeding history, etc.

The patients were grouped broadly into surgical and medical patients. In the surgical patients the practical aspect of postoperative bleeding was a measure of the effect of viosterol in addition to the lowered Ivy bleeding time. In the medical cases, the Ivy bleeding time was of chief value, although cessation of spontaneous bleeding from the gastro intestinal tract or other sources was also an indication of viosterol effect. In general, the average dose of viosterol was 30 drops of 250D three times a day.<sup>1</sup> In cases with acholic stools, bile salts were also administered to insure the absorption of vitamin D. In addition, calcium and glucose were sometimes administered orally or intravenously. This administration was irregular and was done in the control cases in about the same proportion as in the definitive group. For a time viosterol 10 000L was given to some patients, but no difference could be noted in its action and it was discontinued. In general where the bleeding time was not prolonged no viosterol was given, the course was usually uneventful. About one third of the patients with a prolonged bleeding time unselected were used as controls and were not given viosterol.

Altogether 810 patients were studied. There were 376 surgical patients and 434 medical patients.

#### SURGICAL CASES

*1 Chronic cholecystitis and cholelithiasis.* Among the surgical patients 254 were patients with chronic cholecystitis and cholelithiasis, upon whom a cholecystectomy was performed. In this group there were 219 (19 colored and

200 white) who showed no bleeding tendency in any of the preliminary tests. They included 30 men and 189 women. No viosterol was given. In the whole group there were only 3 deaths, all from extrahepatic complications. One patient died of cardiac decompensation 2 weeks after operation, and 2 of bronchopneumonia 10 days after. One patient ran a stormy postoperative course. The rest 215 patients, made an uneventful recovery. The Ivy bleeding time thus seems to have good prognostic value, for when it is normal, good results can be expected, and viosterol is not indicated.

Thirty-five, or 13.7 per cent, of the patients (3 men and 32 women) in this group (Table I) showed a bleeding tendency on the preliminary tests. The Duke bleeding time averaged 120 seconds, well within the normal range, but the Ivy bleeding time averaged 320 seconds, quite above the normal upper limit of 240 seconds. Nineteen of the 35 patients gave a history of abnormal bleeding. The icteric index averaged 11. Of these 35 patients with a bleeding tendency, 24 were given viosterol for from 4 days to 2 weeks before operation in doses of 30 to 60 drops, three times a day. After this therapy, the Duke bleeding time averaged 50 seconds, the Ivy bleeding time dropped to 150 seconds. Twenty-two of these patients made uneventful postoperative recoveries and two ran stormy postoperative courses. There were no deaths.

As a control series 11 of the patients were not given viosterol. Without viosterol preparation, the Duke bleeding time before operation averaged 132 seconds, and the Ivy bleeding time averaged 346 seconds, still well above normal.

Thus in these cases there was no spontaneous improvement in the bleeding time. One patient died in cholemia, and 10 ran stormy postoperative courses, requiring blood transfusions and 4 to 6 weeks' stay in the hospital. There were no smooth recoveries. Here too the Ivy bleeding time was seen to have prognostic value. When it is increased, trouble can be expected unless it is first reduced by viosterol therapy.

It is significant that at operation no unusual difficulty with hemostasis was noted even in the control cases. The patients "went bad"

<sup>1</sup> The viosterol and other drugs used in this work were kindly supplied by Mead Johnson and Company.

TABLE 1—SURGICAL VULVAR BLEEDER CASES WITH BLEEDING TENDENCY

Case number	Sex and color	Age	Icteric index	Bleeding history	Date bleeding time	Ivy bleeding time	Postoperative bleeding	After viostatrol	Bleeding	Date bleeding time	Ivy bleeding time	Postoperative bleeding	Results
153	♀	42	12	0	110	290	30 drops t.i.d. 1 wk	0	60	150	+	0	Recovered
155	♀	48	5	0	140	310	30 drops t.i.d. 1 wk	0	70	110	+	0	Recovered
156	♀	42	10	±	150	310	30 drops t.i.d. 1 wk	0	50	90	+	0	Recovered
443	♀	27	8	±	150	360	30 drops t.i.d. 1 wk	0	60	120	+	0	Recovered
449	♀	40	0	0	140	290	30 drops t.i.d. 1 wk	0	70	120	+	0	Recovered
63	♀	33	5	±	100	440	30 drops t.i.d. 1 wk	0	40	150	+	0	Recovered
226	♀	37	18	±	160	390	30 drops t.i.d. 1 wk	0	70	150	+	0	Stormy convalescence recovered
227	♀	31	12	±	180	330	60 drops t.i.d. 1 wk	0	40	100	+	0	Recovered
228	♀	43	4	0	100	280	30 drops t.i.d. 1 wk	0	70	110	+	0	Recovered
229	♀	45	5	±	190	320	30 drops t.i.d. 1 wk	0	70	100	+	0	Recovered
230	♀	43	20	0	180	450	60 drops t.i.d. 2 wks	0	150	400	+	0	Stormy convalescence
331	♀	41	16	0	110	260	30 drops t.i.d.	0	60	120	+	0	Recovered normal
510	♀	27	+	+	180	420	30 drops t.i.d.	0	70	150	+	0	Recovered normal
511	♀	40	6	+	90	400	30 drops t.i.d.	0	60	180	+	0	Recovered normal
512	♀	63	6	+	100	300	30 drops t.i.d.	0	50	140	+	0	Recovered normal
583	♀	58	0	80	280	30 drops t.i.d.	0	60	110	+	0	Recovered normal	
584	♀	44	5	0	90	290	30 drops t.i.d.	0	60	150	+	0	Recovered normal
585	♀	64	12	+	100	270	30 drops t.i.d.	0	50	110	+	0	Recovered normal
586	♀	41	+	140	280	30 drops t.i.d.	0	80	120	+	0	Recovered normal	
587	♀	54	8	0	90	280	30 drops t.i.d.	0	50	120	+	0	Recovered normal
732	♀	24	+	100	290	30 drops t.i.d.	0	40	50	+	0	Recovered normal	
981	♀	46	20	±	110	360	30 drops t.i.d.	+	140	340	+	0	Stormy P.O. course transfusion CCH 4 wks
633	♀	36	0	90	320	None	None	0	120	300	+	0	Stormy P.O. course transfusion CCH 4 wks
634	♀	56	0	90	270	None	None	0	90	330	+	0	Stormy P.O. course transfusion CCH 4 wks
635	♀	65	8	+	80	None	None	0	130	360	+	0	Stormy P.O. course
636	♀	33	24	±	110	300	None	0	100	360	+	0	Stormy P.O. course
637	♀	38	0	190	400	None	None	+	160	400	+	0	Stormy P.O. course transfusion
154	♀	50	15	0	60	290	None	+	100	380	+	0	Died in 3 days
450	♀	43	0	±	190	290	None	+	100	380	+	0	Stormy P.O. course recovered after 4 wks
311	♀	44	20	±	90	290	None	0	130	300	+	0	Collapse 3 hrs P.O. blood transfusion 4 wks. P.O. ad recovery
312	♀	39	38	+	150	330	None	0	80	270	+	0	Collapse P.O. transfusion 4 wks. ad recovery
753	♀	41	0	+	150	330	None	0	80	270	+	0	Stormy convalescence course transfusion

8 to 24 hours after operation. It occurred to us here that the reason for this is that jaundiced patients clot as quickly as normals, but that their clots are fragile and the postoperative retching, etc., breaks them loose.

We have spent a great deal of time in studying the clots of these patients. The increased fragility of their clots in comparison with normal clots is obvious, but we have as yet been unable to devise an instrument to record this fragility accurately.

**2 Common bile duct stone.** Sixty-four patients with common bile duct stone were operated upon. Of these 27 men and 19 women, showed no bleeding tendency. Their icteric index ranged from 16 to 150, their ages from 24 to 68. None of the 27 received viosterol except patient 26. All made uneventful postoperative recoveries except patients 26 and 24. Therefore in patients with normal Ivy bleeding time, smooth spontaneous recovery can usually be expected without viosterol. Patient 24 was a white woman 46 years old. She had an icteric index of 3, no bleeding history, and a bleeding time which was just within normal limits. She was in excellent general condition. She was not given viosterol, but the night before operation was given 5 cubic centimeters of 10 per cent calcium chloride intravenously. She died suddenly 1 hour after the injection. Patient 26 was a white man 58 years old. He had an icteric index of 130. There was no bleeding history. He had a normal bleeding time, but was in poor general condition. For this reason he was given 30 drops of viosterol three times a day for 10 days. He died 4 days after operation in cholæmia.

Thirty-seven, or 57 per cent, of the patients with common duct stone (11 men and 26 women) had an abnormally prolonged bleeding time. The Duke bleeding time averaged 125 seconds but the Ivy bleeding time averaged 330 seconds. The icteric index averaged 58. Twenty-four of the 37 patients were given viosterol. The bleeding tendency stopped in all, except patient 762. The Duke's bleeding time dropped in from 1 to 2 weeks to an average of 65 seconds, the Ivy bleeding time to 120. There was only 1 death, patient 762, and only 1 stormy postoperative course.

As a control series, 13 of the 37 patients were not given viosterol. The bleeding tendency persisted in 11 of these 13 patients, the Duke's bleeding time rose to an average of 140 seconds, the Ivy bleeding time rose to an average of 385. There were 5 deaths, 8 stormy postoperative courses, and no uneventful recoveries. This stands in striking contrast to the group with prolonged bleeding time who were given viosterol (Table II).

**3 Surgical malignancies.** Twenty-four surgical patients with carcinoma of the liver or of the extrahepatic bile ducts were studied. There were 16 men and 8 women. Fourteen of these patients (10 men and 4 women) showed no bleeding tendency. Their ages varied from 40 to 72. Their icteric index varied from 22 to 120. No viosterol was given. Thirteen of the fourteen had exploratory laparotomies. One patient was in very poor condition when operated upon and died a few hours later. The rest made uneventful postoperative recoveries. One patient had a cholecystogastrostomy with an uneventful recovery.

Ten or 41 per cent of the patients (6 men and 4 women) showed a bleeding tendency (Table III). Six gave a history of bleeding. The icteric index averaged 56. The Duke bleeding time averaged 120 seconds, the Ivy bleeding time 430 seconds. Eight of the 10 patients were given viosterol. The Duke's bleeding time within from 5 to 12 days dropped to an average of 75, the Ivy bleeding time to 190 seconds. Two patients on viosterol retained their bleeding tendency. One died in cholæmia. The other ran a stormy postoperative course. A third patient was relieved of his bleeding tendency but died of cardiac decompensation 2½ weeks after operation. Five of the 6 whose bleeding tendencies were reduced made uneventful postoperative recoveries. As a control series 2 patients were not given viosterol. The bleeding time remained unchanged. Both died in cholæmia.

In these patients, too, the same general relationship holds between the bleeding time and the prognosis. Also, the effect of viosterol in keeping down the bleeding time and bleeding tendency for a time was noted. However, where the liver is hopelessly damaged and no

TABLE II—SURGICAL COMMON BILE DUCT CASES WITH BLEEDING TENDENCY

Case number	Sex and color	Age	Icteric index	Bleeding history	Date bleeding time	Ivy bleeding time	After viosterol	Results
234	♀	45	88	+	310	310	30 drops t.i.d. 2 wks	Recovered
235	♀	38	58	±	160	320	30 drops t.i.d. 2 wks	Recovered
236	♀	48	21	0	100	260	60 drops t.i.d. 1 wk	Recovered
237	♀	48	65	0	120	250	30 drops t.i.d. 1 wk	Recovered
238	♀	40	62	+	130	270	30 drops t.i.d. 3 days	Recovered
239	♀	42	22	±	110	290	30 drops t.i.d. 1 wk	Recovered
161	♂	61	36	0	70	290	30 drops t.i.d. 1 wk	Stormy P O course
423	♀	37	50	0	140	290	30 drops t.i.d. 5 d	Recovered
424	♀	23	46	0	280	480	30 drops t.i.d. 2 wks	Recovered
87	♀	41	36	+	50	240	60 drops t.i.d. 1 wk	Recovered
88	♀	38	89	+	150	240	60 drops t.i.d. 1 wk	Recovered
316	♂	46	260	+	180	360	30 drops t.i.d. 10 d + bile salts 7 gr t.i.d.	Recovered
10	♂	38	53	0	50	260	30 drops t.i.d. 10 d	Recovered
605	♂	30	50	+	120	350	30 drops t.i.d. 1 wk + bile salts 7 gr t.i.d.	Recovered
606	♂	61	45	+	100	280	30 drops t.i.d. 1 wk + bile salts 7 gr t.i.d.	Recovered
514	♀	44	25	0	80	290	30 drops t.i.d. 1 wk	Recovered
515	♀	60	32	+	110	300	20 drops t.i.d. 1 wk	Recovered
516	♂	27	38	+	110	510	30 drops t.i.d. 1 wk	Recovered
2	♀	27	28	++	160	280	60 drops t.i.d. 1 wk	Recovered
5	♂	40	16	++	50	250	30 drops t.i.d. 1 wk	Recovered
27	♂	47	34	+	120	300	30 drops t.i.d. 1 wk	Recovered
761	♀	50	150	0	90	280	30 drops t.i.d. 1 wk + bile salts 7 gr t.i.d.	Recovered
762	♀	50	27	+	130	400	30 drops t.i.d. 1 wk + bile salts 7 gr t.i.d.	Died
162	♀	36	63	+	160	420	No viosterol	Died a few hrs P O of hemorrhage
218	♀	51	81	±	180	410	No viosterol	Died 1 hr P O of hemorrhage
697	♀	61	12	+	90	300	No viosterol	Died 1 day later
698	♀	39	65	+	170	480	No viosterol	Died 1 day later no autopsy
699	♀	39	36	0	100	360	No viosterol	Stormy P O course
700	♀	43	16	+	100	420	No viosterol	Stormy P O course
480	♀	42	28	+	80	270	No viosterol	Stormy P O course
184	♀	29	20	+	70	360	No viosterol	Stormy P O course
317	♀	27	220	++	280	500	No viosterol	P O collapse transfusions wks recovery
758	♂	40	++	+	110	330	No viosterol	Stormy P O course
237	♂	35	++	+	60	420	No viosterol	Stormy P O course
159	♀	44	38	±	100	330	No viosterol	Stormy P O course
160	♀	41	40	+	110	310	No viosterol	Died

TABLE III—SURGICAL MALIGNANCIES WITH BLEEDING TENDENCY AND VIOSTEROL  
Explanatory Operation

Case number	Sex and color	Age	Diagnosis	Icteric index	Bleeding	Duke	Ivy	Viosterol	After viosterol				Result
									Bleeding	Operation	Duke	Ivy	
166	♂	52	Secondary carcinoma of liver	10	0	100	270	30 drops t.i.d. for 1 wk.	0	+	50	100	Recovered
167	♀	58	Secondary carcinoma of liver	12	0	100	260	30 drops t.i.d. for 1 wk.	0	+	60	130	Recovered
117	♀	50	Secondary carcinoma of liver	65	+	170	480	30 drops t.i.d. for 1 wk.	0	+	60	180	Recovered
518	♂	58	Secondary carcinoma of liver	72	+	150	660	30 drops t.i.d. for 1 wk.	0	+	130	120	Recovered
96	♀	61	Carcinoma of gall bladder	90	++	160	480	30 drops t.i.d. for 1 wk. + calcium lactate, glucose and transfusion after 2 wks.	+	+	90	260	Died in 24 hrs. in cholera (8 days, 43 men)
240	♂	54	Carcinoma of gall bladder	10	0	140	260	30 drops t.i.d. 10 days	0	+	70	140	Died in 2 wks of cardiac decompensation
3	♂	48	Carcinoma of gall bladder	44	++	70	540	30 drops t.i.d. 1 wk. + calcium gluconate	±	+	60	240	Stormy P.O. course
61	♀	40	Carcinoma papilla of Vater	18	0	60	270	30 drops t.i.d. 1 wk. + bile salts	0	+	10	90	Recovered
310	♂	40	Secondary carcinoma of liver	46	+	160	350	No viosterol	+	+	150	380	Died 1 day P.O.
55	♂	3	Secondary carcinoma of liver	0	0	60	280	No viosterol	0	+	90	280	Died 1 day P.O.

died by carcinoma, nothing will help it. We were able to follow the gradually advancing destruction of the liver by the gradually increasing bleeding time and the failure of the patient to respond to viosterol.

*Miscellaneous surgical cases.* There were 2 patients with liver abscess. Neither showed a bleeding tendency. No viosterol was given. They were drained surgically, and made uneventful recoveries. One patient with biliary cirrhosis, patient 393, was operated. She was 33 years old and had an icteric index of 150 and no bleeding tendency. She was not given viosterol. While in the hospital her Ivy bleeding time increased from 160 to 300. She was explored at that time. The postoperative course was stormy and the prolonged bleeding time continued for 4 weeks, when she began to recover slowly. One patient with a splenic anemia was operated upon. She was 55 years old and had a very high bleeding tendency (380 seconds Duke, 460 Ivy). No viosterol was given. Splenectomy was done. The patient died 1 week later with recurrent hemorrhages. One patient with a thrombocytopenic purpura, patient 764, had a Duke bleeding time of 510 seconds and an Ivy bleeding time of 670, and a platelet count of 70,000.

She was put on viosterol, but transfusions were also given. Her bleeding time dropped to normal and the platelet count rose to 150,000. Recovery after splenectomy was uneventful.

During the course of the year, 29 tonsil patients were found (out of about 5,000 operated upon) who gave a bleeding history (13 males and 14 females). Their ages varied from 4 to 31 years. Only one of these, however, showed a slightly prolonged bleeding time (260 Ivy). No viosterol was given to any case. All, even the latter, made uneventful recoveries. There were no cases of serious bleeding other than a few cases on the basis of definite surgical injury to larger vessels. There were no deaths. Because of inadequate "bleeding" material, nothing can be said regarding the use of viosterol before tonsillectomy.

#### MEDICAL CASES

*1 Chronic cholecystitis and cholelithiasis.* Eighty-two patients with chronic gall bladder disease entered the hospital with symptoms of biliary colic, acute gastro-intestinal upsets, or chronic dyspepsia. There were 11 men and 71 women. Of these, only 1 showed a bleeding tendency. No viosterol was given. All recovered promptly from their admission symp-

TABLE IV—MEDICAL COMMON BILE DUCT CASES

Case number	Sex and color	Age	Icteric index	Bleeding	Duke	Ivy	Viostrrol	Bleeding	Duke	Ivy	After viostrrol	Result
534	♀	26	29	0	90	470	30 drops t i d 2 wks + bile salts 2 wks	0	90	150	Improved refused operation	Improved refused operation
703	♀	20	19	0	90	450	30 drops t i d 2 wks + bile salts 2 wks	0	70	150	Improved refused operation	Improved refused operation
704	♂	43	62	+	70	450	30 drops t i d 10 days + bile salts 10 days	0	50	140	Improved refused operation	Improved refused operation
696	♂	43	31	0	50	340	Calcium only	0	60	90	Slow improvement refused operation	Slow improvement refused operation
705	♀	33	+	+	160	440	No viostrrol	+	200	430	Died 3 days	Died 3 days
732	♀	45	38	0	80	390	30 drops t i d 1 wk + bile salts	0	80	200	Refused operation	Refused operation
731	♀	48	+	+	0	80	No viostrrol	±		310	Refused operation	Refused operation

forms Operation was not advised for the time being in many of the cases, in the remainder, the patients refused operation and left the hospital One patient, 355, a man 47 years old, entered the hospital with an acute cholecystitis He had a bleeding history and a prolonged bleeding time (Duke 230 seconds, Ivy 550) He was not given viostrrol Operation was advised but he refused and left the hospital

*Common duct stone* Fourteen patients with common bile duct stone were studied who did not come to operation There were 8 men and 6 women Seven patients showed no bleeding tendency They had an icteric index of 27 to 70 No viostrrol was given All made a spontaneous temporary recovery from their jaundice and gastro-intestinal symptoms

Seven patients manifested a bleeding tendency (Table IV) Two gave a history of bleeding, Duke's bleeding time averaged 90 seconds, Ivy bleeding time, 400 seconds The icteric index averaged 38 Four of these were given viostrrol and bile salts The Duke bleeding time within 1 to 2 weeks averaged 70, the Ivy bleeding time dropped to 140 seconds All 4 recovered One patient received calcium only She improved slowly Two patients received no medication The bleeding time remained unchanged in 1 and the patient steadily worse The longer and the patient steadily improved prognosis value of the Ivy bleeding time and efficacy of viostrrol in improving prognosis is shown in these as in the surgical patients

*Empyema of gall bladder* One patient with empyema of the gall bladder, patient 356,

was admitted in poor condition A man 44 years old, was admitted in poor condition Viostrrol was not tried He died in 2 days Another similar patient, 601, was prepared with viostrrol She began to recover spontaneously and refused operation The correct diagnosis in this case is in question

*Catarrhal jaundice* Fifty-one patients with catarrhal jaundice were studied, 36 men and 15 women Thirty-six patients showed no bleeding tendency They had an icteric index of from 18 to 100 Their ages varied from 15 to 55 No viostrrol was given All recovered promptly within 2 weeks

Fifteen patients, or 29 per cent, had a prolonged bleeding time, the Duke bleeding time averaged 115 seconds, the Ivy, 330 seconds (Table V) Twelve gave a history of abnormal bleeding The icteric index averaged 58 Twelve of the 15 were given viostrrol The bleeding tendency stopped in all within 1 to 3 days The Duke bleeding time dropped within 3 to 6 days to an average of 70 seconds, the Ivy to 100 seconds All 12 recovered promptly within from 5 days to 2 weeks Three of the 15 were not given viostrrol One was ill for 7 weeks, 1 for 6 weeks, and only 1 recovered with usual promptness Although catarrhal jaundice is a self limited disease, it seems that when a prolonged Ivy bleeding time clouds the prognosis, viostrrol is of value

*Cirrhosis of the liver* There were 104 patients with cirrhosis, 56 men and 48 women Most of these were peritoneal cirrhosis, a few were biliary Only 4 of the patients were colored Forty-seven patients showed no bleeding tendency No viostrrol was given, but the

TABLE V—CATARRHAL JAUNDICE

Case number	Sex and color	Age	Icteric index	Bleeding in vtry	Duke bleeding time	Ivy bleeding time	Viosterol	After viosterol			Result
								Bleeding	Duke bleeding time	Ivy bleeding time	
94	♀	34	46	+	120	280	30 drops t i d. 1 wk	0	60	140	Recovery 1 wk
95	♀	34	35	+	70	300	30 drops t i d. 10 days	0	80	120	Recovery 10 days
96	♀	38	36	++	120	310	60 drops t i d. 1 wk	0	80	170	Recovery 1 wk
558	♀	45	66	+	90	270	20 drops t i d. 2 wks	0	30	90	Recovery 2 wks
1	♂	54	88	+++	160	260	30 drops t i d. 10 days	0	80	130	Recovery 10 days
8	♂	39	30	+	80	300	30 drops t i d. 2 wks	0	80	130	Recovery 2 wks
53	♂	43	33	+++	70	350	30 drops t i d. 1 wk	0	60	90	Recovery 1 wk
58	♀	14	75	+++	70	400	30 drops t i d. 2 wks	0	70	110	Recovery 2 wks
437	♂	45	28	0	150	170	30 drops t i d. 3 days	0	50	100	Recovery 3 days
256	♂	47	101	++	130	260	30 drops t i d. 1 wk	0	70	130	Recovery 1 wk
757	♀	35	45	+	160	330	60 drops t i d. 1 wk	0	80	140	Recovery 1 wk
54	♀	55	22	0	90	160	10 drops t i d. 1 wk	0	60	90	Recovery 1 wk
552	♀	20	60	+	190	340	No viosterol—2 wks	0	90	180	Finally recovered after 2 wks
678	♀	14	63	+	100	380	No viosterol—6 wks	0	80	350	Left hospital after 6 wks condition only fair
725	♀	6	34	0	120	330	No viosterol—10 days	0	60	90	Recovery 10 days

patients were under observation in the hospital for from 3 to 6 weeks. Their icteric index ranged from 7 to 94, their ages from 36 to 62. Forty two of these patients were stationary while under observations or improved slightly. One patient, 468, a man 38 years old, had a low bleeding time but was nevertheless moribund on admission. He died the next day.

Fifty seven patients or 54 per cent with cirrhosis had a prolonged bleeding time. The Duke bleeding time averaged 128 seconds, the Ivy 350 seconds. Thirty eight of the 57 cases gave a history of abnormal bleeding. The icteric index averaged 44.

Thirty of the 57 patients were given viosterol (Table VI). Six of them died in the course of 3 to 6 weeks, although none was moribund on admission. The bleeding tendency of these 6 did not abate on the administration of viosterol. The Duke bleeding time rose to 190, the Ivy to 460. Two patients were stationary, one made slight improvement. Four patients improved moderately and 17 patients improved markedly while under viosterol treatment. In the 24 patients in this group on viosterol

who survived, the bleeding tendency subsided in from 1 to 4 weeks. The Duke time fell in from 1 to 4 weeks to an average of 75 seconds, the Ivy to 150 seconds. In 2 of the patients who were improving, the viosterol was stopped. One of them became rapidly worse but is still alive, the other died.

Twenty seven of the 57 patients with bleeding tendency were not given viosterol despite their prolonged bleeding time (Table VII). There were 14 deaths, but 9 patients were moribund on admission, therefore, only 5 deaths can be counted to compare with the cases receiving viosterol. The striking contrast was that 9 of the control patients ran a progressive downhill course, 1 was stationary, 1 showed a slight improvement, and only 2 showed a marked improvement when viosterol was withheld. In these last 13 patients who are still living, the Duke bleeding time averaged 90 seconds, the Ivy time remained at 310.

It seems that in cirrhosis of the liver with a prolonged bleeding time, if the process is early or slow in its progress, viosterol has some



TABLE VI—CIRRHOSIS CASES WITH BLEEDING TENDENCY AND VIOSTEROL

Case number	Sex and color	Age	Icteric index	Bleeding history	Date bleeding time	Ivy bleeding time	After viosterol	Bleeding time	Ivy bleeding time	Results
247	♂	51	28	+	60	300	30 drops t i d 4 wks	0	80	Marked improvement
607	♀	42	34	+	130	350	30 drops t i d 3 wks	0	70	Marked improvement
715	♀	40	5	0	90	250	30 drops t i d 3 wks	0	60	Marked improvement
717	♀	24	22	+	130	610	30 drops t i d 4 wks	0	30	Marked improvement
718	♀	42	+	+	50	250	30 drops t i d 3 wks	0	50	Marked improvement
716	♀	48	44	+++	150	350	30 drops t i d 5 wks	0	70	Remainable recovery Viosterol stopped in 4 wks began to go bad 2 wks later bleeding began again Duke 120 Ivy 450
248	♀	38	0	0	90	210	30 drops t i d 2 wks	0	60	Moderate improvement
100	♀	50	0	+	130	280	60 drops t i d 3 wks	100	160	Moderate improvement
101	♀	50	14	+	90	280	60 drops t i d 3 wks	0	90	Moderate improvement
249	♀	56	56	+	110	260	60 drops t i d 2 wks	0	80	Moderate improvement
251	♀	60	20	0	110	260	30 drops t i d 2 wks	0	130	Moderate improvement
717	♀	56	28	+	120	300	30 drops t i d 2 wks	0	60	Moderate improvement
718	♀	37	20	0	120	270	30 drops t i d 2 wks	0	70	Moderate improvement
61	♀	42	16	+	200	270	30 drops t i d 3 wks	0	100	Moderate improvement
713	♀	40	24	+++	110	420	30 drops t i d 4 wks	0	70	Moderate improvement
714	♀	42	+	+	180	500	30 drops t i d 5 wks	0	60	Moderate improvement
465	♀	64	0	0	180	900	30 drops t i d 4 wks	0	180	Moderate improvement
466	♀	33	150	+++	220	320	30 drops t i d 6 wks	0	150	Moderate improvement
719	♀	56	16	+	160	280	30 drops t i d 3 wks	0	80	Slight improvement
250	♀	56	18	±	140	310	60 drops t i d 4 wks	0	100	Slight improvement
13	♀	38	86	+++	120	360	30 drops t i d 1 wk	+++	120	No improvement
							60 drops t i d 2 wks	+++	230	No improvement
							90 drops t i d 2 wks	+++	230	No improvement
32	♀	40	37	+++	140	400	60 drops t i d 2 wks	++	130	Steadily worse died
33	♀	33	76	+	90	300	60 drops t i d 10 days	+	90	Steadily worse died
27	♀	41	6	+	80	260	30 drops t i d 3 wks	++	200	Steadily worse died
119	♀	51	25	++	200	320	60 drops t i d 4 wks	+++	330	Steadily worse died
							3 drops t i d (10 cc) 4 wks	+++	500	Steadily worse died
116	♀	47	73	++	140	450	30 drops t i d 1 wk	+	60	No viosterol 1 day more
							No viosterol 1 wk	0	70	No viosterol 1 day more
							30 drops t i d 1 wk	+	270	No viosterol 1 day more
546	♀	51	+	++	200	310	30 drops t i d 1 wk	+++	230	Died of massive haematemesis
							60 drops t i d 1 wk	+++	270	Died of massive haematemesis
							1000—5m t i d 1 wk	+++	500	Died of massive haematemesis
805	♀	45	147	0	300	+	30 drops t i d 1 wk		310	No change
806	♀	43	16	0	130	430	30 drops t i d 1 wk		110	Slight improvement

value, while if it is advanced or rapid in its progress viosterol has no demonstrable malignancy in and about the liver who did not come to operation. They included 41 men and 6 Malignancy There were 68 patients with

TABLE VII—CIRRHOSIS CASES WITH BLEEDING TENDENCY WITHOUT VIOSTEROL

Case number	Sex and color	Age	Icteric index	Bleeding history	Duke bleeding time	Ivy bleeding time	Viosterol	Life-saving	Duke bleeding time	Ivy bleeding time	Result
465	♂	64		+		510	No viosterol 10 days	0	70	140	Marked improvement
181	♂	48		0	50	550	No viosterol 3 wks	0	30	180	Marked improvement after an attack of erysipelas
711	♀	43	16	0	160	380	No viosterol 2 wks	0	140	300	Slight improvement
330	♀	66	8	0	110	260	No viosterol 3 wks	0	130	300	Stationary
400	♀	59	38	0	80	110	No viosterol 3 wks	0	140	190	Gradually worse
491	♀	30	0	0	80	190	No viosterol 4 wks	0	100	160	Gradually worse
401	♀	48	61	+	100	300	No viosterol 4 wks	+	110	320	Gradually worse
682	♀	52		+	110	400	No viosterol 4 wks	+	130	450	Gradually worse
683	♀	51	40	+	100	340	No viosterol 4 wks	±	90	420	Gradually worse
684	♀	17		0	110	480	No viosterol 4 wks	±	130	320	Gradually worse
46	♂	16	12	++	200	360	No viosterol 1 wk	++		580	Rapidly worse
108	♂	52		+	60	530	No viosterol 1 wk	+		590	Rapidly worse
300	♀	58		±	110	340	No viosterol 1 wk	+	170	400	Rapidly worse
105	♀	5	+	++	110	330	No viosterol 2 wks	+	150	300+	Rapidly worse died
395	♀	42	8	+	100	320	No viosterol 1 wk	+	180	450	Rapidly worse died
301	♀	54	15	0	170	360	No viosterol 1 wk	+	180	440	Rapidly worse died
507	♀	49	12	0	60	190	No viosterol 1 wk	+	110	310	Rapidly worse died
337	♀	14		+	140	80	No viosterol 1 wk	+	170	300	Rapidly worse died
48	♀	1		++	200	500+	No viosterol				Moribund died
54	♀	51		+	80	300	No viosterol				Moribund died
606	♀			++	110	400	No viosterol				Moribund, died
35	♂	54	8	+	80	190	No viosterol				Moribund, died
681	♂	28		+	40	280	No viosterol				Moribund, died
60	♂	35	67	+++	200	300	No viosterol				Moribund, died
609	♀	45		+++	21	430	No viosterol				Moribund, died
304	♂	64	++	+	600+		No viosterol				Moribund, died
50	♀	51		0	80	300	No viosterol				Moribund, died

27 women. Forty five of these patients showed no bleeding tendency. Thirty eight of them were secondary carcinomata of the liver, 1 was a carcinoma of the gall bladder, 3 were carcinoma of the head of the pancreas, and 3 were carcinomata of the common bile duct. No viosterol was given. All were under observations for 2 to 7 weeks. All were either stationary or showed only a slow decline except 2 patients 404 and 794. Patient 404 was a man 69 years old with an icteric index of 145. He had a low bleeding time but died apparently of cardiac decompensation. Patient 794

died although the bleeding time was normal.

Twenty three of the 68 patients showed a bleeding tendency (Table VIII). There were 15 secondary carcinomata of the liver, 4 of the common bile duct, 3 of the pancreas and 1 of the gall bladder. The Duke bleeding time averaged 150 seconds, the Ivy, 355. Eight of these were given viosterol. Three died, but 1 was moribund when treatment was started. Two became steadily worse, 2 remained unchanged, and 1 improved slightly. In this group, the Duke bleeding time remained at 130, the Ivy at 330.

TABLE VII—MEDICAL MALIGNCIES WITH BLEEDING TENDENCY

Case number	Sex and color	Age	Diagnosis	Icteric index	Bleeding	After viosterol	Healt
62	F	54	Carcinoma of stomach	31	±	50 drops t i d 3 wks	Slightly improved refused operation
721	F	54	Secondary carcinoma of liver	30	0	30 drops t i d 3 wks	Steadily worse
348	F	70	Secondary carcinoma of liver	130	+	60 drops t i d 1 wk	Steadily worse
106	F	89	Secondary carcinoma of liver	150	+	60 drops t i d 1 wk + cal cum lactate	Steadily worse
105	F	10	Secondary carcinoma of liver	0	100	50 drops t i d 1 wk	Died
476	F	76	Secondary carcinoma of liver	3+	970	10 drops to 000X t i d	Moribund died
99	F	51	Carcinoma extra hepatic bile ducts	4+	70	30 drops t i d + bile salts	Died
768	F	61	Carcinoma extra hepatic bile ducts	100	0	30 drops t i d + bile salts 1 wk	No change
722	F	55	Carcinoma of gall bladder	90	++	40 No viosterol	Worse
410	F	43	Secondary carcinoma of liver	110	0	140 No viosterol 1 wk	Worse
412	F	51	Secondary carcinoma of liver	0	110	280 No viosterol 2 wks	Died
423	F	53	Secondary carcinoma of liver	86	0	260 No viosterol 1 wk	Died
411	F	65	Secondary carcinoma of liver	0	50	80 No viosterol 3 wks	Died
403	F	43	Carcinoma of gall bladder	52	0	200 No viosterol	Died
347	F	38	Carcinoma head of pancreas	72	+	260 No viosterol	Died
720	F	58	Secondary carcinoma of liver	50	4+	350 No viosterol	Died
473	F	72	Secondary carcinoma of liver	0	120	600 No viosterol	Died
689	F	59	Secondary carcinoma of liver	92	4+	390 No viosterol	Died
690	F	60	Secondary carcinoma of liver	50	3+	420 No viosterol	Died
61	F	59	Carcinoma of gall bladder	125	+	380 No viosterol	Died
792	F	50	Carcinoma head of pancreas	72	0	310 No viosterol	Died
796	F	47	Carcinoma of common duct	4+	+	430 No viosterol	Died
795	F	65	Secondary carcinoma of liver	+	+	560 No viosterol	Died
794	F	70	Carcinoma of common duct	4+	+	50 No viosterol	Died

Fifteen patients were not given viosterol. Twelve died, but 5 were moribund on admission, leaving 6 deaths to compare with 2 of the other series. One patient became slightly worse, none showed even slight improvement. The Duke bleeding time remained at 130, the Ivy at 350. Viosterol was of no demonstrable value in these cases.

7 Cardiac decompensation with jaundice. There were 9 patients, 5 men and 4 women. Seven of them showed no bleeding tendency. All gradually improved under the usual cardiac therapy. One case was given viosterol but made no better improvement than the others. Two patients had prolonged bleeding time. One patient, 266, a man 41 years old, had an icteric index of 46, a Duke bleeding time of 150, and an Ivy bleeding time of over 600 seconds. He was moribund on admission. Viosterol was not given. He died the next day. One patient, 414, a man 57 years old, with an icteric index of 36 and an Ivy

TABLE IX.—TOXIC HEPATITIS WITH BLEEDING TENDENCY

Case number	Sex and color	Age	Diagnosis	Icteric index	Bleeding	Duke	Ivy	Viosterol	After viosterol			Results
									Bleeding	Duke	Ivy	
107	F	58	Luetic hepatitis	65	0	40	150	No viosterol 1 wk.	0	70	180	Getting worse
								No viosterol 2 wks	±	200	300	Getting worse
								30 drops 1 1/2 d. 1 wk	0	70	250	Improving
								60 drops 1 1/2 d. 1 wks	0	50	130	Recovered
110	F	33	Toxic hepatitis	28	+	200	350	60 drops 1 1/2 d. 1 wk	0	80	150	Recovered
62	M	18	Toxic hepatitis	100	0	60	350	30 drops 1 1/2 d. 10 days	0		70	Recovered
725	M	27	Toxic hepatitis	60	0	120	260	3 drops 10,000% 1 1/2 d. 1 wk	0		60	Recovered
550	M	25	Toxic hepatitis		+	100	500	No viosterol	0	70	150	Recovered
57	F	34	Toxic hepatitis	52	0	100	260	No viosterol	0	70	120	Recovered
786	M	30	Toxic hepatitis	++	+	290	610	No viosterol	+		150+	Worse
787	M	43	Toxic hepatitis	60	0	120	250	5 drops 10,000% 1 1/2 d. 1 wk.	0		60	Improved recurrence
			(Second admission)	58	++	210	410	30 drops 1 1/2 d. 1 wk	0		140	Recovered

bleeding time of over 600, was given large doses of viosterol (60 drops three times a day). He died in 3 days. Viosterol was of no value in these cases.

**8 Toxic hepatitis.** Fourteen patients with toxic hepatitis were studied, 4 women and 10 men. Six showed no bleeding tendency and recovered promptly. Eight had prolonged bleeding times (Table IX). The Duke bleeding time averaged only 88 seconds, but the Ivy averaged 310. Five were given viosterol. Three were not. All recovered promptly. The Duke bleeding time decreased to 65 seconds, the Ivy dropped to 110. Of course no effect from viosterol was demonstrated. However 1 patient, 107, a colored woman 58 years old had a low bleeding time on admission. Viosterol was not given. She began to grow worse. Viosterol was then given, she improved rapidly. Patient 787 had a prolonged bleeding time which dropped to normal under viosterol therapy. Treatment was stopped and he left the hospital. He returned 1 month later with recurrent hemorrhages and prolonged bleeding time. Viosterol again brought his bleeding time down to normal and stopped his bleeding.

**9 Miscellaneous.** There were 15 patients with jaundice with miscellaneous conditions such as pneumonia, portal thrombophlebitis, ascending cholangitis, pyelonephritis, miliary

tuberculosis, and Banti's disease (Table X). Viosterol was given in most of the cases in which the Ivy bleeding time was prolonged. The results seemed to depend largely on the basic condition rather than on the jaundice. At any rate, there were too few similar cases in this series to warrant conclusions.

**10 Pernicious anemia.** Seventeen patients with pernicious anemia were studied, 7 women and 10 men. Eleven had no bleeding tendency and showed a prompt remission under liver therapy. Six patients showed a bleeding tendency (Table XI). The Duke bleeding time averaged 150 seconds, the Ivy 340. Four were given viosterol and 2 were not. All, however, showed a prompt remission. The Duke bleeding time fell to 60 seconds, the Ivy to 115.

**11 Leucæmia.** There were 11 patients with leucæmia. Three of these, chronic myeloses had no bleeding tendency. Viosterol was not given. They improved slightly while under observation and left the hospital. Eight of the leucæmias showed a marked bleeding tendency (Table XII). The Duke bleeding time averaged 380 seconds, the Ivy 500 seconds. Six of the patients were given viosterol, 2 were not. The bleeding time went even higher in all and all patients died. Viosterol was of no value in these cases.

TABLE V—MISCELLANEOUS MEDICAL JAUNDICED CASES WITH BLEEDING TENDENCY

Case number	Sex and color	Age	Diagnosis	Itch index	Breeding	Duke	Ivy	Yosterol	After yosterol	Result
52	♀	40	Portal thrombophlebitis	18	+	+	320	30 drops t i d 10 days	00	Recovery
60	♀	33	A-cending pyelonephritis	95	+	+	350	30 drops t i d 1 wk	0	Recovery
63	♀	33	Ban's disease	95	+	+	590	No yosterol	+	Died
179	♀	40	Ascending cholangitis	31	0	140	320	No yosterol	+	Died
801	♂	0	Pneumonia	37	0	160	340	30 drops t i d 9 days	0	Recovery
808	♀	33	Pneumonia	32	0	120	340	No yosterol	+	Id
802	♀	35	Kemp's of gall bladder	+	140	380	30 drops t i d 10 days + bile salts	0	70	Recovery
156	♀	44	Kemp's of gall bladder	32	0	370	No yosterol			Died

TABLE VI—PERNIOUS ANEMIA

Case number	Sex and color	Age	Breeding	Duke	Ivy	Vasotrol	Blood urea	Urea	Ivy	Result
478	♀	6	+	280	500+	60 drops 1 i d 1 wk 60 drops 1 i d 1 wk 60 drops 1 i d 1 wk	0	120	450	Remission Boggs 5 mm Howell 12 mla Platelets 130 000
477	♂	33	+++	290	40 drops 1 i d 1 wk 40 drops 1 i d 1 wk + liver	0	0	140	160	Remission Howell 9 mm Platelets 110,000
480	♀	46	+	240	350	30 drops 1 i d 2 wks + liver	0	60	90	Remission Boggs 4 mm
559	♂	37	0	200	280	5 drops 10 000 1 i d 3 days + liver	0	60	130	Remission Boggs 4 1/2 mm Platelets 100 000
727	♂	58	0	30	260	No vasotrol liver only	0	50	100	Remission
728	♀	54	0	160	370	No vasotrol liver only	0	40	100	Remission

12 Secondary anemia. Fourteen patients with secondary anemia were studied. Six of them showed a prolonged bleeding time (Table XIII). The results of viosterol therapy, however, were inconclusive.

of septic purpura showed normal bleeding time. Violesterol was not given, all recovered promptly. Nine patients had prolonged bleeding times (Table XIV). Of these 1 case of septic purpura improved, while another similar case did not improve under violesterol therapy. Two patients with toxic purpura were given violesterol and recovered. Of the 6 patients with thrombocytopenic purpura, 2 were not given violesterol. They grew slowly worse. Two were given violesterol, 1 gradually

TABLE XII—LEUCÆMIAS

Case number	Sex and color	Age	Diagnosis	Bleeding	Duke	Ivy	Viosterol	After viosterol			Result
								Bleeding	Duke	Ivy	
7	♂	34	Monocytic leucæmia	3+	850+		30 drops t.i.d. 3 wks.	4+	1000+		Died platelets 1 300 000
191	♀	45	Lymphatic leucæmia	2+	210	400	30 drops t.i.d. 1 wk. + X-ray therapy	2+	240	400	Died Howell 7 mm
359	♂	18	Acute leucæmia	4+	100+		5 drops 20,000 U. t.i.d. 1 wk.	4+	600+		Died
360	♀	16	Acute leucæmia	4+	300	600+	60 drops t.i.d. 1 wk. 5 drops 20,000 U. t.i.d. 2 wks. 5 drops 20,000 U. t.i.d. 3 wks.	4+ 4+ 4+	350 340 380	600+ 600+ 600+	Died
111	♂	4	Acute leucæmia	4+	500+		30 drops t.i.d. 1 wk.	4+	500+		Died
118	♀	46	Myeloid leucæmia	3+	400		30 drops t.i.d. 5 days	4+	500+		Died platelets 420 000
182	♀	31	Myeloid leucæmia	3+	160	500+	No viosterol				Died platelets 350 000
486	♀	46	Lymphatic leucæmia	+	100	400	No viosterol				Died

TABLE XIII—SECONDARY ANÆMIAS

Case number	Sex and color	Age	Diagnosis	Bleeding	Duke	Ivy	Viosterol	After viosterol			Result
								Bleeding	Duke	Ivy	
115	♀	16	Secondary anemia	3+	160	350	30 drops t.i.d. 4 days	0	60	110	Improved
116	♂	13	Secondary anemia	+	100	280	30 drops t.i.d. 3 days	0	50	130	Improved
6	♂	17	Erythroblastic anemia	3+	80	380	30 drops t.i.d. 1 wk. 30 drops t.i.d. 2 wks. 30 drops t.i.d. 3 wks.	0 0 0	70 75 70	160 140 80	Platelets 600 000 R.B.C. 1 900 000 W.B.C. 17 000
61	♂	3	von Jaksch's anemia	2+	480+		15 drops t.i.d. 2 wks.	+	500+		Subcut. liver therapy R.B.C. 2 300 000 W.B.C. 26 000 died
40	♂	61	Nephritic anemia	3+	1000+		60 drops t.i.d. 3 days				Died
188	♂	64	Secondary anemia bleeding gastro-intestinal carcinoma	3+	90	360	30 drops t.i.d. 2 wks.	+		180	Gastric resection died in shock

bleeding tendency. Two were given viosterol, one was not, all died.

15 *Other miscellaneous patients* There were 11 miscellaneous patients without jaundice. These included patients with hemophilia, Bantist's disease, scurvy, pellagra, tularæmia, ascites etc. (Table XV). Viosterol was given to all patients with a bleeding tendency but there were too few similar cases to warrant conclusions. One patient with dermatographism had no bleeding tendency but was given viosterol to observe its effect. There apparently was no effect. The patient had a severe attack of "hives" while under treatment.

It is interesting to note that in 5 apparently normal individuals who were found to have a prolonged bleeding time (Table XV), the

bleeding time returned to normal after from 2 to 5 days of viosterol administration.

#### SUMMARY AND CONCLUSIONS

There is no single method of predicting a bleeding tendency which is applicable to all types of hemorrhagic diatheses. In the various types of bleeding dyscrasias, it is probable that various factors are responsible, and that different tests are required to demonstrate the bleeding tendency in each. Thus, in purpura the platelet count, in hemophilia the Howell method of coagulation time determination, are the most reliable methods of predicting a bleeding tendency. In jaundice or in any liver deficiency, neither of these methods nor the Biffi, nor Bogg, nor Lee and White method of

TABLE XIV—PURPURA

Case number	Sex and color	Age	Diagnosis	Bleeding	Duke	Ivy	Viosterol	After viosterol			Result
								Bleeding	Duke	Ivy	
125	♀	17	Septic purpura	+	120	300	30 drops t.i.d. 3 wks	0	30	120	Recovered
122	♀	14	Septic purpura	+	130	120	30 drops t.i.d. 3 wks	+	170	130	No improvement
210	♂	40	Toxic purpura	+	100	180	30 drops t.i.d. 1 wk	0	40	110	Recovered
21	♀	65	Toxic purpura	+	70	260	30 drops t.i.d. 1 wk	0	40	70	Recovered
416	♀	24	Thrombocytopenic purpura	++++	80	490	No viosterol 1 wk	++++	90	260	Steadily worse
453	♂	30	Thrombocytopenic purpura	++	250	390	No viosterol 3 wks	3+	180	380	Platelets 60 000
59	♂	24	Thrombocytopenic purpura	++	80	300	30 drops t.i.d. 2 wks	0	80	120	Impaired
119	♀	14	Thrombocytopenic purpura	4+	600+	1000+	No viosterol blood injected	1+	170	280	Hoggs & Howell 7 platelets 40 000
			No further bleeding for a month of observation	2+	120	390	30 drops t.i.d. 3 days	0	80	120	Platelets 180 000
120	♀	53	Thrombocytopenic purpura	4+	1000+		60 drops t.i.d. 1 wk	4+	1000+	120	Died platelets 40 000
764	♀	27	Thrombocytopenic purpura	4+	510	670	30 drops t.i.d. and 3 blood transfusions	0	90	180	Splenectomy platelets rose from 70 000 to 150 000 before operation recovery

TABLE XV—MISCELLANEOUS

Case number	Sex and color	Age	Diagnosis	Bleeding	Hoggs	Duke	Ivy	Viosterol	After viosterol			Result
									Bleeding	Duke	Ivy	
180	♀	53	Hemophilia	4+	180	290		lactate + hemos + calcium	3+	150	320	Steadily worse
								lactate + hemos + calcium	1+	90	250	Howell 35 mm
								lactate + hemos + calcium	3+	150	340	
								lactate + hemos + calcium	3+	170	410	
9	♂	50	Dermatograpia	0		80	50	30 drops t.i.d. 1 wk	0	110	170	No improvement
								30 drops t.i.d. 2 wks	0	60	90	No attack of liver
								30 drops t.i.d. 3 wks	0	60	90	under treatment
15	♂	19	Normal (threshold)	0	45	140	370	30 drops t.i.d. 5 days	0	100	140	Satisfactory
16	♂	32	Normal (threshold)	+	5	80	240	30 drops t.i.d. 5 days	0	80	120	Satisfactory
17	♂	33	Normal (threshold)	0	4	50	230	30 drops t.i.d. 3 days	0	60	100	Satisfactory
18	♀	35	Normal (threshold)	0	6	70	260	30 drops t.i.d. 3 days	0	60	130	Satisfactory
19	♂	15	Normal (threshold)	+	5	70	290	30 drops t.i.d. 2 days	0	50	100	Satisfactory

determining the coagulation time, nor the ordinary Duke method of determining the bleeding time, nor the fibrinogen content, nor the prothrombin content, nor the total calcium nor the sedimentation rate is reliable

Among many modifications of the Duke test and other tests presumed to determine the bleeding tendency, the only one which we found to be reliable in cases of hepatic deficiency, was an application of the Duke method after

TABLE XII—LEUCÆMIAS

Case number	Sex and color	Age	Diagnosis	Bleeding	Date	Try	Vio terol	After viosterol			Result
								Bleeding	Date	Try	
7	♂	54	Monocytic leucæmia	3+	820+		30 drops t.i.d. 2 wks	4+	1000+		Died platelets 220,000
101	♀	45	Lymphatic leucæmia	2+	210	400	30 drops t.i.d. 1 wk. + X-ray therapy	2+	140	400	Died Howell 7 min.
339	♂	18	Acute leucæmia	4+	300+		5 drops 10,000λ t.i.d. 1 wk.	4+	400+		Died
350	♀	16	Acute leucæmia	4+	300	600+	60 drops t.i.d. 1 wk. 5 drops 10,000λ t.i.d. 2 wks. 5 drops 10,000λ t.i.d. 3 wks	4+ 4+ 4+	330 140 380	600+ 600+ 600+	Died
337	♂	4	Acute leucæmia	4+	500+		30 drops t.i.d. 1 wk.	4+	300+		Died
118	♀	46	Myeloid leucæmia	3+	460		30 drops t.i.d. 5 days	4+	300+		Died platelets 420,000
183	♀	31	Myeloid leucæmia	3+	260	500+	No viosterol				Died platelets 350,000
436	♀	46	Lymphatic leucæmia	+	200	400	No viosterol				Died

TABLE XIII—SECONDARY ANÆMIAS

Case number	Sex and color	Age	Diagnosis	Bleeding	Date	Try	Viosterol	After viosterol			Result
								Bleeding	Date	Try	
115	♂	26	Secondary anemia	3+	160	350	30 drops t.i.d. 4 days	0	60	110	Improved
116	♂	33	Secondary anemia	+	100	280	30 drops t.i.d. 3 days	0	50	130	Improved
6	♂	17	Erythroblastic anemia	3+	80	180	30 drops t.i.d. 1 wk 30 drops t.i.d. 2 wks 30 drops t.i.d. 3 wks	+ 0 0	70 70 5	260 140 80	Platelets 600,000 R.B.C. 1,900,000 W.B.C. 17,700
61	♂	3	von Jaksch's anemia	2+	480+		15 drops t.i.d. 2 wks.	+	500+		Subcut. liver therapy R.B.C. 2,100,000 W.B.C. 18,000 died
40	♂	62	Nephritic anemia	3+	1000+		60 drops t.i.d. 3 days				Died
185	♂	64	Secondary anemia bleeding gastro-intestinal carcinoma	3+	90	360	30 drops t.i.d. 2 wks.	+		180	Gastric resection died in shock

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It is interesting to note that in 5 apparently normal individuals who were found to have a prolonged bleeding time (Table XV), the

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#### SUMMARY AND CONCLUSIONS

There is no single method of predicting a bleeding tendency which is applicable to all types of hæmorrhagic diatheses. In the various types of bleeding dyscrasias, it is probable that various factors are responsible, and that different tests are required to demonstrate the bleeding tendency in each. Thus, in purpura the platelet count, in hæmophilia the Howell method of coagulation time determination, are the most reliable methods of predicting a bleeding tendency. In jaundice or in any liver deficiency, neither of these methods nor the Biffi, nor Bogg, nor Lee and White method of



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2 Before exploration for probable malignancy in and about the liver the same results apply unless liver damage is too far advanced

3 In medical cases of gall bladder disease or common bile duct stone viosterol therapy is also indicated, if the Ivy bleeding time is prolonged. If then has some value, but its effect is not as striking as in the surgical cases

4 In catarrhal jaundice, viosterol hastens recovery only in case of prolonged bleeding time

5 In cirrhosis of the liver, viosterol is indicated in patients with a prolonged Ivy bleeding time and is of value provided the hepatic damage is not too far advanced or too rapid in its progress

6 In the medical cases of malignancy in and about the liver, viosterol has no particular therapeutic value

7 Viosterol was of no demonstrable value in the miscellaneous jaundices due to cardiac decompensation, pneumonia, toxic hepatitis, Bant's disease, portal thrombophlebitis, etc

8 Viosterol was of no particular value in the bleeding tendencies resulting from the blood dyscrasias such as pernicious anemia, leucemia, secondary anamia, hemophilia, etc, nor was its value sufficiently demonstrated in our small series of purpura, scurvy, endocarditis, and miscellaneous bleeding histories

9 Before tonsillectomy, bleeding histories may be checked by bleeding time determinations but our series of positive bleeders was too small to warrant conclusions

10 The data on the relationship of the prolonged Ivy bleeding time and the effects of viosterol to blood chemistry changes will be reported in a separate communication

## MECHANICS OF THE PHYSICAL SIGNS IN LOWER TRUNK INJURIES

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**M**OST injuries of the lower trunk involve the soft tissues only, are not demonstrable in roentgenograms, and must be studied clinically (10). The diagnosis of the lesions in which roentgenograms are negative is important from a therapeutic standpoint. The various results of trauma call for different treatment and thereby necessitate differential diagnosis. In compensation cases accurate diagnosis is important in order to distinguish between the malingerer and the honest claimant.

This paper is limited to the lower trunk injuries which involve the ischiogluteal bursa, the sciatic nerve, the ligaments and joints of the lumbar spine, the sacrum, the coccyx and the hip. In all these injuries there is pain on motion of the trunk and of the extremities. To ascertain what the condition is, to differentiate it from hysteria and from malingering, we must analyze the pain producing and the pain relieving motions. A specific pain producing motion is usually named after the man who originally described it as a sign of one pathological condition. Thus flexion of the straight leg at the hip joint elicits pain in the dorsum of the thigh in sciatic neuritis, and is called Lascegue's (9) sign. The same motion elicits pain in the sacro iliac region in sprain of the sacro iliac ligaments and is then called Goldthwaite's (8) sign. Outward rotation of the semiflexed thigh may be limited and painful in lesions of the hip joint and is then called Patrick's or Laguerre's sign. But the Patrick-Laguere motion may produce pain in sacro iliac and in lumbar sprain. We have learned that, with few exceptions, the signs are not pathognomonic. Errors in diagnosis or failure to gauge the extent of the disability frequently are due to a misunderstanding of the physiology of the body motions used in the examination. The purpose of this article is to describe the physiological basis of the examination. A brief review of the pathology is first presented.

*Sprain of ligaments* The function of a ligament is to limit motion of a joint. It follows that the ligament must be just long enough to permit the physiological motion, and to endure a certain amount of stress when there is any force attempting to exceed the physiological motion of the joint. In contradistinction to muscle tissue, ligaments have a minimal power of elongation. When a force is sufficient to overcome the resistance of the ligaments, there is an injury to the ligamentous tissue which we call a sprain. The longer the ligament the greater is the degree of motion beyond the physiological required to produce sprain. Where the motion between two bones is very small and the connecting ligaments short, the amount of movement beyond the normal required to strain that ligament is very slight. In a ligament like the lumbosacral, where the amount of physiological motion is small, a sprain can be produced by a motion forcing the ligament to stretch as little as an eighth of an inch. If the ligament is long, as in the ankle joint, it permits a wide range of motion, and several degrees of motion in excess of the normal are required to injure the ligament. The severity of sprains varies. Some give mild pain for a few minutes only, others give pain for months.

Pathological examination in the early stages of sprain shows tearing of some of the fibers of the ligament, with bleeding, subsequent examinations show the usual stages of inflammation and repair with scar tissue formation. If there is much scar tissue, its contraction results in shortening of the ligament. The shortened ligament will decrease the range of motion which was possible before the injury.

The bases for diagnosis of sprain of a ligament anywhere in the body are (1) an area of swelling over the ligament, (2) a definitely localized point of tenderness over the ligament, (3) a spasm of the muscles which prevents stress on that ligament, (4) relief of pain when assuming a position which relieves that ligament of stress, (5) production of pain on

logical condition following sprain, the signs and symptoms of which are referable to the area of the sacro-iliac joint. In such cases it is found that any motion or position which puts stress on the ligaments of the sacro-iliac joint elicits pain. Any force that puts stress on the ligaments can also produce that minute motion which we know normally exists in this joint. Can the pain be due to sacro iliac arthritis? Possibly—but motion so minute as to be demonstrable only in the dissected specimen does not elicit pain in any other joint except in fulminating inflammations. That the lesion is localized in the ligaments is the most reasonable hypothesis. Opinion on the pathology may differ. The signs and symptoms constitute a clear cut clinical entity. It must be remembered that nearly every motion that puts stress on the sacro-iliac ligament also puts some stress on the ilio-lumbar combination with strain of the sacro iliac ligaments. The name sacro-iliolumbar sprain is more accurate. Nevertheless the name sacro-iliac syndrome for a combination of physical signs has been in use so long that a change in the name is not desirable.

*Synovitis and periarthritis.* The synovial membrane is a thin sheet of endothelium-like cells which invests the inner side of the capsular ligament of all true joints. Direct trauma (a blow) or indirect trauma (excessive stress on the capsular ligament) may produce an aseptic inflammatory process in this membrane. Synovitis frequently is manifested by an exudate in the joint. Usually the exudate is absorbed completely in time, and the joint resumes its normal function. In more severe cases, the exudate is fibrous and the capsular ligament adheres to the joint surfaces resulting in painful and decreased range of motion. As the synovial membrane is intimately connected with the inner side of the capsular ligament, it is not possible to have a traumatic synovitis without some injury to the ligament. The ligamentous injury may resolve before the synovial exudate is absorbed so that clinically only the synovitis is of importance. On the other hand, the injury to the capsular ligament ever, there is no doubt that there is a patho-

Schmorl has established the importance of the intervertebral disks in the pathology of the spine. If the lesion in some traumatic spine injuries is in the intervertebral disks and not physical signs must be similar. Functionally the disk is an elastic ligament connecting two vertebral bodies. As in sprain of the other intervertebral ligaments pain is elicited when these two bodies move on one another. The motions causing or relieving pain will be similar to those of sprain of the true ligaments between the two vertebrae.

Ghomley has recently described injury to the cartilage of the articular joints of the spine, a true traumatic arthritis. He believes that the sudden onset of symptoms with "locking" indicates injury to the cartilage. The occasional sudden relief of symptoms on manipulation is also indicative of an intra-articular lesion rather than a ligament sprain. Most authorities believe that traumatic arthritis is an exceptional complication.

The controversy as to whether there is any such thing as traumatic subluxation of the sacro-iliac joint has continued for decades, sometimes merely and often acrimoniously. As there is no direct evidence for its existence, I prefer not to use the term subluxation. However, there is no doubt that there is a patho-

assuming a position which puts stress on that ligament

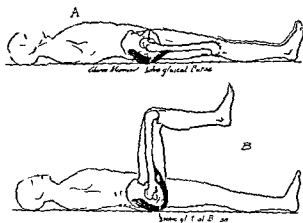


Fig. 1. Effect of flexion of the thigh on the gluteus maximus muscle: the relation of the muscle to the ischio-gluteal bursa is shown.

and the neighboring ligaments may give serious symptoms so that the amount of joint fluid and its absorption are secondary. The inflammatory reaction to trauma in the joint ligaments constitutes a peri arthritis. In some joints the presence of fluid is easily demonstrated. In the interarticular joints of the vertebrae in the sacro-iliac and the sacrococcygeal joints such demonstration is not possible. In an occasional case of sprain of the hip ligaments a fullness in the groin suggests fluid in the hip joint. In general the only clinical evidence of synovitis in lower trunk injuries is pain when the involved joint is moved. But pain results from the same motion if there is traumatic inflammation of the capsular ligament of that joint. Clinically, no distinction can be made between synovitis and peri arthritis in these joints. The clinical diagnosis of peri arthritis therefore, includes the signs and symptoms of any associated synovitis.

The sacrum and coccyx are separated by a fibro elastic disk analogous to the intervertebral disk of the movable vertebrae. A synovial lined joint is sometimes present and at times absent. Traumatic coccygodynia is a sprain of the sacrococcygeal ligaments. Had we any means of knowing that there is a true joint space in a particular case, it would be called a peri arthritis.

**Post-traumatic neuritis.** The pathology and the mechanism of the production of traumatic neuritis are not definitely known. In 36 of 47

cases examined, the history or physical examination indicated that it was a sequel of lumbar or sacro iliac sprain. This is approximately the proportion reported by others (4). Some authors (13) regard it as a radiculitis, and I believe this is correct. I use the term sciatic neuritis in the sense of an organic affection of the sciatic nerve.

**Bursitis.** Ischio-gluteal bursitis is an inflammation of the lining of the bursa lying on the tuberosity of the ischium under the gluteus maximus muscle. The lining membrane is similar to the synovial membrane of a joint. There is usually fluid in the injured bursa.

### EXAMINATION

It is unnecessary to discuss the importance of a general examination to exclude non traumatic lesions. Many visceral diseases give rise to referred pain in the back. The outstanding characteristic of referred pain is that it is not dependent upon motion or posture of the body (16) in sharp contrast with the pain of lower trunk injuries.

The contours of the body, the gait, the manner of sitting down and of getting on the examining table must be observed. A spastic muscle by its pull will determine certain anatomical deformities such as scoliosis in unilateral lumbar muscle spasm. Besides the deformities there are functional changes in posture. The patient will avoid pain by holding his body in such a position as to put the least tension or pressure on the injured tissue. Posture may be defined as the unconsciously assumed position of relief. The postures assumed in some of the lesions under discussion are quite characteristic and should be studied in conjunction with the positions of relief and of aggravation found on examination.

The active and passive motions of the trunk and extremities are tested. The important data to ascertain are which motions elicit and which relieve pain, at what angle of motion the first pain is elicited, and what degree of limitation of motion is present. In examining sprains of some joints, such as the ankle, it is a simple matter to find the motions which elicit pain and those which relieve it. In examining for lower trunk injuries the motions producing relief and aggravation of the pain are more

complicated, as their effects are indirect. In the following descriptions the motions are grouped to aid in understanding their direct and indirect mechanical effects, the sequence is not the one commonly used in a physical examination. In all unilateral lesions a description of a lesion on the left side is given

COCCYGOXYRIA

*Inspection and palpation* In sitting the patient at times puts his weight on one ischial tuberosity, and at times on the other. When he lies on his back on the examining table there is no tendency to flex the knee or hip. External pressure over the coccyx produces pain. The pain is usually more marked the nearer the tip of the coccyx the pressure is applied because this means greater leverage for movement at the sacrococcygeal joint. On rectal examination some pain is elicited on pressure over the anterior surface of the coccyx. The sacrotuberous ligament may be palpated on each side as it passes laterally from the sacrococcygeal junction to the ischial tuberosity. Pressure on one or both of these ligaments may elicit pain because their lower fibers are continuous with the sacrococcygeal ligaments

*Determination of pain producing motions* Abduction, rotation, or hyperextension of the thighs or hyperextension of the spine have no effect on the coccyx and produce no pain. With the patient on his back, the examiner gently flexes one thigh on the abdomen. This motion produces pain accurately referred to the coccyx. Flexion of the other thigh elicits the same pain. How does motion at the hip joint affect the region of the coccyx? The gluteus maximus muscle arises from the ilium, sacrum, and coccyx and is inserted in the upper part of the shaft of the femur. High flexion stretches this muscle (Fig. 1) and pulls on the coccyx. This results in pain analogous to that produced by direct pressure over the coccyx. In the standing position flexion of the trunk produces some pain. Flexion of the trunk on the thighs has the same effect on the gluteus maximus as flexion of the thighs on the abdomen and therefore elicits the same pain. Resumption of the erect posture is even more painful. In resuming the erect posture the

gluteus maximus muscle is not only stretched but there is an active contraction of the muscle resulting in increased pull on the coccyx. With the patient sitting, trunk flexion has a similar effect on the gluteus maximus muscle but the contraction of the gluteus maximus is not as strong and the pain, though present, is less severe. The reason for the posture is obvious. The patient sits on one tuberosity to avoid direct pressure on the coccyx. He does not flex the thighs because this results in pull on the coccyx

ISCHIOGUTTEAL BURSITIS (LEFT)

*Inspection and palpation* The patient sits with the weight on the right ischial tuberosity, never shifting to the left. There may be some tendency to keep the left thigh less flexed than is normal in the sitting position. When the patient lies on the table, the legs are kept straight without any tendency toward flexion of the hip or knee. With the patient lying face down, there is an area of tenderness over the left ischial tuberosity—none on the right. The inflamed ischiotubercular bursa usually contains sufficient fluid so that it is palpable on gentle pressure over the buttock. There is no tenderness over the buttock. The region of the sacrococcyx, and rectal examination is negative. *Determination of pain producing motions* With the patient lying on his back on the examining table, flexion of the left thigh elicits pain which is referred to the buttock, but not definitely localized. Flexion of the opposite thigh produces no pain. Rotation or hyperextension of either thigh has no effect.

The ischiotubercular bursa is located between the gluteus maximus muscle and the ischial tuberosity. Flexion of the thigh stretches the gluteus maximus muscle and therefore puts pressure on the tender ischiotubercular bursa (Fig. 1). Rotation and extension of the thigh put no pressure on the bursa, and therefore have no effect. In the standing and in the sitting position, flexion of the trunk produces the same pain as flexion of the thigh because we have the same stretch-hip flexion because we have the same pain as flexion of the trunk produces the same pain. Flexion of the trunk on the thighs has the same effect on the gluteus maximus as flexion of the thighs on the abdomen and therefore elicits the same pain. Resumption of the erect posture is even more painful. In resuming the erect posture the

It was found that the test was positive on all pigmented solutions or pigmented residues resulting from the use of various extractives on whole urine or urine evaporated to dryness. Colorless solutions resulting from extractions failed to give a positive test. Finally urine was evaporated to dryness and the residue treated with ethyl alcohol. To the resulting solution, which contained the majority of the pigment, ether was added and the pigment precipitated out. The precipitated pigment was redissolved in ethyl alcohol, reprecipitated with ether, and finally taken up in water. The pigment was not completely extracted by these procedures, but it was considerably concentrated. It was found that the more concentrated the pigmented solution the more intensely positive was the Visscher Bowman test. It is fair to conclude from these facts that the substance undergoing change in the Visscher Bowman test is the urinary pigment itself.

For absolute proof of this point it would be necessary to isolate the urinary pigment in pure form and to subject to the Visscher Bowman test the pigment as well as the other urinary constituents from which it was isolated. No adequate method however for the separation of the urinary pigment in pure unchanged form is at present available. The chemical constitution of the urinary pigment and even its identity as a single substance responsible for the color of urine is apparently unknown. Its origin in the body and its metabolism likewise are obscure.

Heldmayer believed that urochrome (urinary pigment) was not a definite substance but composed of two components designated as urochrome A and B. Drabkin (1) using an ingenious method of extraction finally succeeded in sufficiently concentrating and segregating the pigment to get a colored crystalline compound with solochrome and Long Tswelt's method of chromatographic analysis he concluded that the urinary pigment (urochrome) was a single substance. In another paper (2) using as a standard for color comparison a saturated weakly alcoholic solution of basic alizarin to which a small amount of a weak solution of aniline orange had been added he determined the daily excretion of urinary pigment of a group of males and females and concluded that the daily pigment output for males is about 100 units (90 units per square meter body surface) and for females about 127 units (82 units per square meter). A unit equaled the pigment content of 100 cubic centimeters of urine the color of which just matched the standard color as described. He also declared that the

urinary pigment was endogenous in origin and did not depend on the diet and that the urinary pigment output paralleled the basal metabolic rate, being increased in hyperthyroidism and after thyroxin administration. Finally, he found that the urinary pigment was increased in acidosis and during pregnancy, tending to fall slightly before parturition. Our results, though based on samples of morning urines rather than on total daily outputs, suggest that the latter conclusion is correct. As noted in Table I, only 34 per cent of pregnant females just before delivery gave a definitely positive Visscher Bowman test. The specific gravity of the urine in many of these (not determined for all) ranged from 1.001 to 1.015. In interpreting this finding we feel that beside the factor of absolute decrease in urinary pigment output, the factor of increased diuresis also plays a part. Moreover, of the 7 strong positives in this preparturient group, 2 were cases of toxemia, 1 of pneumonia, and 1 required delivery of a dead fetus by cesarean section, all presumably oliguric.

In the Visscher Bowman test the degree of positivity of various urines roughly paralleled the specific gravity but did not do so exactly. Inasmuch as the urinary pigment, however, is not the only substance that contributes to the specific gravity, no conclusion regarding the absolute urinary pigment output can be derived from the study of this relationship between the specific gravity and the gradations noted in the Visscher Bowman test.

One other property of the urinary pigment mentioned by Drabkin is of importance here, i.e. its conversion in the presence of strong mineral acids (concentrated sulphuric acid, concentrated hydrochloric acid) into dark red or definitely black melanin like substances. This is a point in favor of our previous conclusion that the Visscher Bowman test merely represents a change in the normal urinary pigment in the presence of strong mineral acid.

Until the urinary pigment has been definitely isolated in pure form, evidence for its chemical constitution will necessarily be fragmentary and even conjectural. Drabkin found that the Millon test on the partially purified urinary pigment was fairly strongly positive, indicating the presence of a hydroxy phenyl group. With this observation as a lead, an artificial pigment was prepared, agreeing in many of its properties with those of the urinary pigment itself. An aqueous solution of diorphenylalanine (1:1000) was mixed with crude potato oxidase (3) in the proportion of 2 parts of the former to 5 parts of the



related substance with a hydroxy phenyl group and that its chemistry is probably tied up with that of melanin and its precursors. It is not in conceivable that further intensive study of the urinary pigment, with particular regard to its isolation, the determination of its chemical constitution and its relationship to metabolism, may help to solve the problem of melanin, its metabolism and excretion, for the urinary pigment is a soluble substance which *in vitro* can be converted into a substance quite similar to the material called melanin.

#### SUMMARY AND CONCLUSIONS

- 1 The Visscher Bowman test is not a chemical test for pregnancy. Positive tests were obtained with urines from males, non pregnant females of various ages and children below the age of 12.
- 2 Estrin and prolan do not give positive reactions.
- 3 The test is in reality a change in the normal urinary pigment (urochrome) induced by heating with strong mineral acids and resulting in the formation of red soluble and black melanin like insoluble substances.
- 4 The output of urinary pigment, previously shown by Drabkin to be increased in pregnancy and roughly to parallel the basal metabolic rate, is here found not to parallel the urinary prolan.
- 5 An artificial pigment is described with physical (solubility) properties and some chemical reactions similar to those of the normal urinary pigment.

6 The need of further intensive study of the urinary pigment and the metabolism of its precursors is emphasized. It is conjectured that the solution of this problem may help solve the problem of melanin and its metabolism.

I acknowledge my indebtedness to Dr. Frederick Parker Jr. for the suggestion that initiated this investigation and for the helpful criticism and advice given by him as the work progressed.

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## INTUSSUSCEPTION DURING PREGNANCY

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THE able monograph of Treves on *In-  
festinal Obscurum* published in 1884  
and stress upon the tendency of intra-  
luminal tumors to provoke invagination  
of the bowel.

Wichmann's detailed analysis of 725 cases of intestinal lymphoma, reviewed from December 1960 to December 1969, was widely approved. The lymphoma came from Germany, the Netherlands, Belgium, France, and the United States. The histologic study of tumor invagination of the intestine, Blotot and Corcard and, later, King contributed from America comprehensive reviews of intussusception and intestinal tumors, respec-

research for a responsible tumor whenever they "sense" the presence of which they advise patients, the physician, and the patient. At times, to be certain of the location of the tumor, the physician may use a variety of techniques, such as the use of a small, flexible, fiberoptic tube, which is inserted into the rectum and pushed up to the tumor. The tube is then pushed up to the tumor, and the physician can see the tumor through the tube. The tube is then pulled out, and the tumor is removed. The tube is then pushed up to the tumor, and the physician can see the tumor through the tube. The tube is then pulled out, and the tumor is removed.

## DURING PREGNANCY

Steinhart (1870) This patient 41 years old, had a nervous constitution. At the fourth month of pregnancy

infant was born at term. The mother recovered slowly and remained a semi-invalid. Conceivably, this patient suffered from tuberculosis, not until 1882, and Koch dis-

Bull (1871). Between the second and third months of gestation, a woman 28 years of age in her fourth pregnancy, was treated medicinally for intestinal obstruction. On the seventh day she passed 3 centimeters of small intestine and improved immediately. No comment is made upon the time or the character of her delivery. She suffered from chronic constipation and had a history of

May-Johnson (1885). Patient, 33 years of age, at third month of pregnancy had an intussusception beginning 4 feet 2 inches from the commencement of the duodenum. Laparotomy resection of 4 feet of gangrenous intestine, from the Hospital of The Good Samaritan.

the intussusception was unknown  
to end anastomosis. Death 4 hours later. Cause of  
Wylie (1888) (Xiphopara, 6 months pregnant had se-  
vere pains in right lower abdominal quadrant. There was  
profuse bleeding from the rectum on the fifth day of illness,  
passages of a large clough of blood on twelfth day. Con-  
valescent on fifteenth day. Spontaneous delivery at term.  
Well, 3 months later. No discussion of pertinent etiology.  
Ayer (1890) Intussusception during pregnancy in a  
tuberculous woman. Death 100 days following expulsion  
of a fecal of small intestine, and 47 days after confinement.  
Premature, in a child. Autopsy of the mother by Keganald  
Fitz showed tuberculous of lungs, liver, and intestine. Two  
narrowed to  $\frac{1}{4}$  inch  
Croliou (1890) Intussusception masked by miscarriage  
The rhythmic abdominal pains were associated with  
uterine contractions. Cervix closed. Four days later a  
delivery of a stillborn, 7 months fetus. Death of mother 4  
hours postpartum. Autopsy showed invagination of  
gangrenous gut above ileocecal junction.  
Geissler (1894) (Xiphopara, 44 years of age, bearing ex-  
haustion from symptoms attributed to vomiting of preg-  
nancy. An abortion was performed, and death ensued a  
centuries later. Autopsy showed an intussusception, 15  
centimeters long at junction of duodenum and jejunum,  
involved by an intraluminal myoma, 5 centimeters long,  
with a broad base  
Williams (1908) Intussusception at the site of a tu-  
berculous ulcer. Resection and anastomosis. Death soon  
after the operation.  
Kohler (1920) (Xiphopara, 29 years of age, 8 to 9 months  
pregnant, presented symptoms of ileus. Delivered by vaginal  
incision, subsequent laparotomy disclosed a kink in the  
small intestine, attributed to an intussusception which had  
retracted itself. Autopsy showed purulent peritonitis, and  
the portion of ileum gangrenous. Parenchymatous ne-  
phritis. Diebench (1922) (Xiphopara, 31 years of age. Fundus

Tumor in left upper abdominal quadrant, pain vomiting. Tumor breads above the umbilicus, 7 months pregnant. No movement of bowels for 2 days. Diagnosis of intestinal obstruction (intussusception?). Laparotomy revealed an aggregated loop of small intestine, rotated 180 degrees. Resection of 1 1/2 meters of small intestine, rotated 180 degrees. Spontaneous delivery, at term, normal infant.

Stork (1923) Primipara 26 years of age, 9 months pregnant. Manifestations of leus included fecal vomiting.

Laparotomy revealed an invagination of the upper small

intestine, 20 centimeters long. Resection and anastomosis followed by Cesarean. The fetus was stillborn, the mother died shortly.

autopsy revealed infarction of intestine 30 centimeters long. Thirteen days postpartum she passed 36 centimeters of intestine. Death occurred 2 weeks later. Autopsy revealed infarction of intestine 30 centimeters long.

Williams (1908) Infundus at the site of a tumor section and anastomosis. Death soon after the operation.

Köhler (1920) *Trimpura*, 29 years of age, 8 to 9 months pregnant, presented symptoms of leus. Delivered by vaginal section, subsequent laparotomy disclosed a kink in the small intestine, attributed to an intussusception which had released itself. Autopsy showed purulent peritonitis, and the portion of ileum gangrenous. Panchymatous neoplasms.

Dierich (1922) *Trimpura*, 31 years of age. Fundus 2 finger breadths above the umbilicus, 7 months pregnant. Tumor in left upper abdominal quadrant, pain vomiting no movement of bowels for 3 days. Diagnosis of intussusception.

obstruction (intussusception?) Laparotomy revealed an invaginated loop of small intestine, rotated 270 degrees. Resection of  $\frac{1}{2}$  meters of small intestine lateral anastomosis. Spontaneous delivery, at term, normal infant. Stork (1902) Primipara 26 years of age, 9 months pregnant. Manifestations of ileus included local vomiting. Laparotomy revealed an invagination of the upper small intestine, 20 centimeters long. Resection and anastomosis followed by Cesarean. The fetus was stillborn, the mother died shortly.

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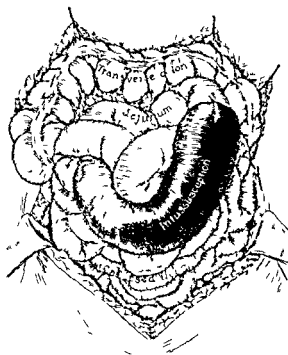


Fig 1 Frontal view of abdominal cavity after removal of the uterus (diagrammatic)

from stomach. Abdomen contained 2 liters of fluid in which floated particles of food.

Porak (1902) Patient 34 years of age in her third pregnancy. During labor the pains were of exceptional violence. Temperature was subnormal, pulse rapid, fetus stillborn. Mother collapsed 3 hours after delivery. Laparotomy revealed an intussusception of the small bowel 72 centimeters long. Death during operation. Hospital history of pulmonary tuberculosis for 3 years.

#### DURING THE PUERPERIUM

Ponick (1874) Delivery by version. Uterus was ruptured just above bladder. The rent was covered with extensive omental adhesions obstructing the large bowel which became greatly distended and the ileum prolapsed into the colon. Finally perforation. Fatal peritonitis 8 weeks postpartum.

Krabbel (1896) Intussusception on eighth day post partum. Passed 48 centimeters of intestine 10 days later. Death on fiftieth day. Autopsy revealed cavities in both lungs. Scar 15 centimeters above ileocecal valve. Several ulcers in intestines.

Czerny and Rindfleisch (1892) Patient, 36 years of age had had no normal pregnancies. Three months after her last delivery the mother suddenly fell ill with manifestation of ileus. Nine days later laparotomy revealed an ileocecal intussusception. Resection of 72 centimeters of intestine. Death 10 hours later. Autopsy revealed diffuse peritonitis, fluid in both pleural cavities.

Köhler (1920) Multipara 6 weeks after delivery presented manifestations of obstruction. Laparotomy disclosed an ileocecal intussusception 40 centimeters long. As the patient appeared extremely ill treatment was limited to drainage. Autopsy revealed peritonitis.

Maxwell and Wong (1932) Quinipara, 39 years old admitted to the Peiping hospital the day following delivery at home. Intussusception of midportion of ileum. Under local anesthesia the obstructed loop was removed and the cut ends of the bowel sutured into the abdominal wound. Death 45 minutes after the operation.

Spoto (1934) Secundipara with intussusception of the ileum into the cecum the twenty first day after normal delivery. Resection and lateral anastomosis was followed by peritonitis. Death on sixth postoperative day.

#### AUTHORS' CASE

Primigravida age 36 years had last menstrual period August 16 1935. Patient gave past history of operation for breast tumor a blue dome cyst and of hemorrhoids treated medicinally, otherwise her health had always been excellent.

The course of pregnancy proceeded normally until February 10 1936 when the fundus was found at the same level as 1 month before. Fetal movements were vague. She was annoyed by nose bleed, also by a boil on the left labium minus.

About 2:00 a.m. Thursday February 13 she awakened with cramps and nausea. At first the symptoms were transient, permitting a little sleep between the attacks. She took only tea for breakfast, and vomited that. Toward noon the cramps became severe, the vomiting frequent.

On admission to the hospital at 3:00 p.m. the vital signs were: temperature 98 degrees, pulse 60 respirations, 18. The cervix was 1 inch long, hard, canal closed. Pantopon was given hypodermically. Half an hour later the nurse reported the patient had gone into shock. She was visited at once and found literally in a "cold sweat," pale, screaming with pain at consistent intervals of 5 minutes. The temperature was 96 degrees, pulse, 44 and irregular. Blood pressure was 110/0. Specific gravity of the urine 1025. Alkaline reaction, no sugar, heavy trace of albumin, acetone positive, diacetic acid negative, microscopically, a few leucocytes and epithelial cells but no casts were noted. Blood tests showed 45 per cent hemoglobin, erythrocytes 3,000,000, leucocytes 9,300 with neutrophils 83 per cent, lymphocytes 16.5 per cent, monocytes 0.5 per cent.

At this point it became apparent to the obstetrician that some factor besides miscarriage was concerned in the problem. Accordingly, an internist and a surgeon were called in consultation. The situation then was thus summarized: a prostrated patient with profound pallor, mentally clear, agonizing pains at 5 minute intervals associated with strong uterine contractions. Rectum was 23 to the minute but not labored or irregular. Pulse of poor quality, 40 to 50 to the minute, quite irregular. The uterus, clearly outlined, reached to the umbilicus, otherwise no abdominal tumor was felt. Moderate abdominal distention with movable dullness in both flanks was noted. No external bleeding was present.

Immediate treatment was limited to blood transfusion and dextrose solution intravenously with opiates in appropriate dosage. The beneficial effects of the transfusion were evident immediately, pulse became regular and the rate increased to 70.

February 14 The patient's condition was improved, the pulse regular 80 to minute and of good quality. Pains still severe, vomiting intermittent. X-ray plates showed gas in the stomach and in one loop of bowel but none under the diaphragm, no evidence of a ruptured hollow viscus. Blood chlorides were 356 milligrams per cent. The patient was given 2000 cubic centimeters of dextrose solution (5 per cent) intravenously. In response to an enema there was a small soft brown defecation.



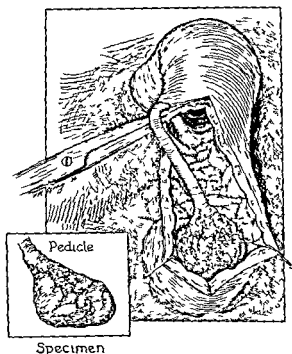


Fig. 3. Necrotic adenoma of the jejunum

17 of them never having caused symptoms were discovered at operations undertaken for other reasons.

Adenomas which predominate among these neoplasms may be located anywhere in the bowel though the sites of predilection are its two extremities—a significant distribution, because that portion of the small intestine which first forms in the embryo ultimately becomes the duodenum and the terminal ileum. Other facts, too, support the embryological origin of these neoplasms. For example, an adenoma was found in the duodenum of an infant coming to autopsy, for other reasons, a few days after it was born at the Johns Hopkins Hospital. Tarnowsky and Sarma treated an intussusception caused by jejunal adenoma in an infant of 4 months. Raiford records a tumor of this type and location in a child of 6 months, Joyce another in a young boy. Likewise, their occurrence in two members of the same family favors Cohnheim's congenital theory. Van Dijk and Oudendahl report operations upon a young man and his sister for similar symptoms, a single jejunal adenoma was found in the woman, 3 in her brother.

Upon occasion the same tumor has provoked intussusception repeatedly. Wilmoth's patient experienced symptoms referable to this phenom-

non on four occasions. Iason and Filberbaum report a case with 2 operations, Joyce another with 3. With his patient gravely ill, Watts was compelled merely to reduce the intussusception. Within a week at a second operation he released a recurrent invagination and excised an adenoma. Later a third operation was required for resection of the terminal ileum containing a number of similar tumors. Many reports illustrate the prevalence of multiple adenomas, the most impressive being that of Officer in a child 9 years old. 41 adenomatous polyps were found at autopsy, scattered along the intestinal tract from stomach to rectum.

#### MECHANISM OF INVAGINATION

Where an intraluminal, pedunculated tumor is the provocative agent, the mechanism of intussusception becomes the simplest. Normal peristalsis apparently grips the tumor, as it would a bolus of food, and attempts to move it onward. The force of the tug transmitted along the pedicle pulls the wall of the intestine toward the lumen. If the traction be stronger than the resistance of the musculature which opposes it, a lateral invagination will become complete. But this plain hypothesis does not explain why intussusception occurs at one time rather than another. For that purpose we may imagine the development of "rush waves" which have been studied minutely by Meltzer and Auer, or some other extraordinary type of peristaltic activity. The stimulus which inaugurated the invagination in our patient must have been the hearty meal she ate the night before. A coarse diet popular in Northern latitudes has been held responsible for a relatively high incidence of intussusception in certain countries, for example Finland.

Here is the law of the intestine in Starling's words, "stimulation at any point of the gut causes contraction above the point of stimulus, and relaxation below it." This order of events permits invagination, and it will occur even though the existing conditions be purely physiological. Auer writes to us, "I have twice seen an intussusception form in the apparently normal small gut of the rabbit. The intussusception occurred in a matter of seconds, once it released itself, spontaneously the second time I released it manually after waiting a few minutes." The phenomenon has actually been photographed by Alvarez in his film, "Intestinal Peristalsis."

Each of the factors in normal peristalsis, contraction and relaxation, has been singled out as the cardinal feature in the mechanism of intussusception. At first Preyer (1877) announced the

stance which Sugito later isolated in crystalline form. It possessed toxic properties. In the material above a jejunal obstruction. Nesbitt identified choline and neurine. Kukulka, cadaverine dogs, thus obstructed in the experiments of Jensen and Fitor, died in some instances within 48 hours and in others lived for 7 to 8 days. Comparable variations appeared in the composition and toxicity of the contents of the obstructed loop, sometimes choline, histamine, and cadaverine were plentiful, sometimes not. The variability was attributed to the bacteria which happened to be present.

Of late emphasis has been placed upon the physiicochemical changes in the body-fluids of individuals suffering from obstruction. The findings have been summarized by Guest and Andrus (1) as increased concentration of the blood, (2) increased non-protein nitrogen, (3) reduction of chlorides, (4) high carbon dioxide combining power, (5) loss of electrolytes, including bases and chlorine, a loss which reduces the ionic content of the body-fluids, (6) rapid general dehydration, (7) an increase of inorganic phosphates.

As these phenomena suffice to explain the constitutional symptoms, including those referable to renal damage, it becomes unnecessary to predicate the absorption of poisonous material from the bowel. Nevertheless, such material has been demonstrated in closed loop experiments, and likewise in cases of intestinal gangrene.

#### EFFECTS UPON PREGNANCY

The toxemia associated with ileus creates a grave hazard for a pregnancy. High obstruction is more mischievous than low, prostration in turning to surgical treatment augments the intoxication. And the prognosis with intussusception becomes very grave, unless the necrotic segment of bowel, after auto-amputation, is passed by rectum. This spectacular termination attended 6 of the 20 cases known to us. In 4 the event occurred during, or prior to, the sixth month of pregnancy, of these, 3 were delivered of viable infants near term. The fourth report does not tell how the pregnancy ended. Such previous results intimate that the obstruction was relieved promptly, several days before the slough of bowel was passed. The pertinent mechanism will be discussed later. It will suffice here to contrast the fate of the fetus in these circumstances with its fate after more or less delay in turning to surgical relief of the mother.

Reviewing nearly 300 pregnancies complicated by ileus of various kinds, Essen-Møller found that the fetus perished in from two-thirds to three-

fourth of the pregnancies. The findings of intestinal obstruction in the body-fluids of individuals suffering from obstruction. The findings have been summarized by Guest and Andrus (1) as increased concentration of the blood, (2) increased non-protein nitrogen, (3) reduction of chlorides, (4) high carbon dioxide combining power, (5) loss of electrolytes, including bases and chlorine, a loss which reduces the ionic content of the body-fluids, (6) rapid general dehydration, (7) an increase of inorganic phosphates.

Growing recognition of the frequency with which intraluminal tumors cause invagination of the bowel is significant in the act of invagination. The requisite stimulus, purely local, acts simultaneously upon circular and longitudinal fibers, then it becomes easy to understand how invagination takes place. There is no experimental evidence to show that paralysis of a part of the bowel is significant in the act of invagination. The frequency with which intraluminal tumors cause invagination of the bowel has been an incentive to thoughtful consideration of the underlying mechanical problem. Hypothetical suggestions of numerical importance, are not lacking, but as yet, no completely satisfactory solution has been offered. Heimonen is convinced that, if any of the theories suggested hereafter were correct, intussusception attributable to a congenital growth should never be delayed until the period of middle life. During the intervening years, he believes, supplementary anatomical changes occur, changes which facilitate invagination. A partial blocking of the intestinal lumen, Heimonen argues, will lead to hypertrophy of the musculature above the obstruction, atrophy below it. These developments favor intussusception, because they interrupt the transmission of nerve impulses essential to normal peristalsis. Imperfect nerve control, also, is conducive to the attenuation of the intestinal segment below the tumor, a microscopic finding he has noted repeatedly. Relative to this hypothesis we have no evidence, the material required for study was not available.

#### THE INTOXICATION OF ILEUS

Every one agrees that the intoxication incident to ileus becomes most pronounced when an obstruction is located in the upper part of the small intestine. But opinions differ as to whether its manifestations are caused by specific poisons, or by alterations in the physicochemical composition of fluids that are normal constituents of our bodies. Stone, and Bernheim obtained a proteose like substance, and from closed loops of the upper bowel, Whipple,

TABLE I  
During Pregnancy

No	Date	Report by	Month	Cause	Treatment	Mother	Fetus
1	1870	Steinhart	4	Tuberculosis?	Slough passed in stool	Recovered	Normal
2	1871	Bull	2-3	Tuberculosis	Slough passed in stool	Recovered	?
3	1885	Robson	3	Undetermined	Resection	Died	Undelivered
4	1888	Wylie	6	Undetermined	Slough passed in stool	Recovered	Normal
5	1890	Ayer	6	Tuberculosis	Slough passed in stool	Died	Premature
6	1890	Crofton	7	Undetermined	Miscarriage	Died	Died
7	1894	Geussler	8	Jejunal myoma	Abortion	Died	Died
8	1908	Williams	?	Tuberculosis	Resection	Died	Undelivered
9	1920	Kohler	8-9	Undetermined	Vaginal section and laparotomy	Died	Died
10	1922	Dietrich	7	Undetermined	Resection	Recovered	Normal
11	1925	Stork	9	Undetermined	Cesarean Intestinal resection	Died	Died
12	1936	Authors	6-7	Jejunal adenoma	Hysterectomy Reduce invagination Excise tumor	Recovered	Removed in utero
Labor							
13	1858	Ibba	Term	Tuberculosis?	Slough passed in stool	Died	Normal
14	1902	Porak	Term	Tuberculosis	Exploratory laparotomy	Died	Died
Puerperium							
15	1874	Poudick	Term	Adhesions	None	Died	?
16	1890	Krabbel	Term	Tuberculosis	Slough passed in stool	Died	Normal
17	1892	Czerny	Term	Undetermined	Resection	Died	Normal
18	1920	Kohler	Term	Undetermined	Resection	Died	Normal
19	1932	Maxwell	Term	Undetermined	Resection	Died	Normal
20	1934	Spoto	Term	Undetermined	Resection	Died	Normal

fourths of the cases. His statistics included still births, infant deaths after spontaneous delivery, and deaths due to the premature termination of pregnancy by artificial means. With respect to intussusception during gestation, omitting the instances of spontaneous anastomosis, we have 8 pregnancies for consideration. Among them 1 infant was born alive, 3 were stillborn, 2 pregnancies ended by abortion, 2 mothers died undelivered.

The maternal mortality in this series of 20 cases (Table I) was at least 75 per cent. The ultimate result was not given in one instance (Bull). In two (Steinhart and Wylie), after passing necrotic bowel at the fourth and sixth month respectively, the mother was delivered spontaneously near term and subsequent developments were not related. Dietrich cured his patient permanently by a massive resection and our own recovered. On the other hand, a fatal termination was recorded explicitly in 15 instances.

#### TUBERCULOSIS

The presence of tuberculosis in several instances warrants comment. Williams's case was shown

to be due to a tuberculous ulcer. Porak's patient had been treated for pulmonary tuberculosis in an institution. The autopsy upon Ayer's case disclosed tuberculosis of the lungs, liver, and intestines. Krabbel's patient had cavities in both lungs. Circumstantial evidence points toward tuberculosis in the cases of Steinhart, Bull, and Ibba. Among all the patients who passed intestinal sloughs that of Wylie alone gives no hint of the fundamental etiology. The association of tuberculosis with spontaneous anastomosis is surely more than a coincidence.

Enteric ulceration facilitates spontaneous cure of an intussusception, because the ulcer which provides "the fixed point" of the mechanism having already suffered tissue loss establishes an area of low resistance. The nutrition of the thin tissue at its base becomes further impaired, immediately the blood supply is reduced by vascular compression within the intussusception. Perforation of the ulcer may transform a complete into an incomplete obstruction. Then progressive necrosis will widen the aperture, restoring the lumen of the bowel, more or less effectively. And

the anatomical relations are such as to protect the peritoneal cavity from contamination, for the ulcer pertains to the intussusceptum, ensheathed within the intussuscipiens.

Meanwhile, at the neck of the intussusception, amputates the sloughing cylinders under conditions favoring auto-anastomosis. This hypothesis does not assume the ulcer to be at the head of the intussusception. That is not essential. It was described a specimen in which the perforation was located in the inner and middle cylinders, some distance above the apex, and at autopsy, fecal material followed a channel downward between the intussuscipiens and the intussusceptum. Incidentally, this authority regards auto-anastomosis as an imperfect device, hemorrhage, cicatricial stenosis, or perforation follows customarily.

The passage of sloughs has also been observed when intussusception was due to an inverted Meckel's diverticulum (Bockhoven), tape-worms (Thompson), and lesions of the large intestine (Wallon). In all these incidents, which happened to men, the degree of occlusion was merely partial. Agn, Charles Mayo has reported sloughing of an intussusception subsequent to enterostomy, upon a boy too ill for radical treatment. Apparently, *incomplete obstruction* is a pre-requisite of auto-anastomosis.

# DISCUSSION

The patient should give a helpful history, since tumors that involve intussusception cause primary ailments, customarily, but these may be trivial and easily forgotten, or, if severe, attributed to a dietary indiscretion. The information the physician obtains relates ordinarily to the intussusception alone the acute manifestations of which he has been called to treat.

The attack begins with the vomiting of food, later of a bile-stained fluid. Cramps at regular intervals defy accurate localization, for the pain usually is diffuse and radiating. Constipation prevails, yet evacuations of blood and mucus occur in 80 per cent of the cases. The temperature, pulse, and respirations are not characteristic, if shock occurs, the time of its appearance is inconsistent. As a rule, the abdomen becomes moderately distended tenderness is slight. A tumor typically in the umbilical region, becomes palpable in 25 per cent of the enteric cases. No diagnostic finding carries more weight, though it does not exclude volvulus. The size of the tumor varies from patient to patient, also from time to time in the same individual. Hard, movable,

painful, the most characteristic feature of the tumor is its shape, a sausage with concavity toward the mesentery.

Rhythmic abdominal pains associated with intussusception imitate the familiar phenomena of parturition, and the two situations, co-existent, forbid distinction. Accurate diagnosis during pregnancy also proves impossible, unless the obstructed bowel becomes palpable, as in the cases of Mayo-Robson and of Dietrich. With our patient the tumor, displaced upward beyond the costal margin, remained undemonstrable. Neither was blood passed by rectum.

Röntgenography is apt to be curtailed by circumstances precluding the use of a barium meal. However, even with that technique incorrect inferences have been drawn. Higgins made a diagnosis of pyloric stenosis, and operation revealed a jejunal adenoma causing intussusception. Mansell found that plates useless, and so it was with Garsleben and others including ourselves. Rarely, the roentgenologist has made a correct diagnosis of intraluminal tumor prior to intussusception. Adjacent adhesions assisted Marr and Alvarner in locating the lesion, after barium administration. More precisely, Waters recognized a duodenal papilloma from its association with a vacuolated type of filling defect. But, such assistance is exceptional. The limitations imposed upon barium studies—the difficulty of ill-

Fig 4 Photomicrograph of the necrotic adenoma



ing the whole of the small intestine, its mobility, and the presence of superimposed loops—seriously hamper exact localization

Speaking of intussusception invoked by an intraluminal tumor, Raiford reached this sound conclusion "the clinician must rely upon the history and the physical examination of the patient, content to miss the recognition of a tumor, the differentiation of volvulus from strangulation, even to be uncertain of obstruction, if his judgment be so good as to insist upon abdominal exploration"

#### TREATMENT

The treatment of intussusception is a matter of agreement and requires the briefest statement here. Surgery alone is orthodox, if reduction proves impossible, resection becomes imperative. Moreover, the presence of pregnancy places upon the surgeon additional responsibilities, some sentimental, others of the utmost practical significance. All relate to the question: What shall be done about the fetus?

Contemporary obstetrical teaching with respect to the complication of ileus holds that delivery should be effected by cesarean section, provided the mother is near term, otherwise, the pregnancy should be left alone. The wisdom of applying this rule strictly to cases of intussusception is doubtful. We are confronted there with a severe intoxication, especially when the obstruction lies in the upper part of the small intestine. And we must take into account not only its immediate relief but also 2 other contingencies, the possibility of a speedy onset of labor and the postponed birth of a dead fetus.

The sequence of needful surgical procedures should be determined at the outset, and whatever treatment the pregnancy will receive must be executed first. It has become axiomatic that an unwarrantable risk attends cesarean section together with an incidental appendectomy. A still greater risk will be assumed whenever intestinal anastomosis immediately precedes cesarean section.

The chances of postoperative miscarriage, or some other untoward event, can never be accurately foretold. Upon the strength of the patient, the period of obstruction, the character and magnitude of the surgical procedure required to restore intestinal function—upon these details, and others, the outcome will depend. Therefore, the policy pursued should fit the circumstances. And the gravity of intussusception during pregnancy justifies any sacrifice that will favor the survival of the mother. For adopting another attitude in a case of mechanical obstruction,

Noble expressed deep regret "My difficulty," he wrote, "of finding anything in the abdomen except the seventh month pregnant uterus and the difficulty of dealing with the adherent bowel, when we did find it, makes me believe it would be wise in such a case to do the hysterectomy promptly."

Our views are in harmony with those just quoted. Yet we would not be misunderstood. We do not advocate cesarean section, with or without removal of the uterus, in every case of intussusception. Our conviction is that the treatment should be chosen, without prejudice, to afford the pregnant woman an opportunity to recover, as nearly as possible, like that given one who is not pregnant.

#### SUMMARY

There are 20 known instances of intussusception associated with childbearing: 12 during pregnancy, 2 at the time of labor, 6 in the puerperium. Tumors were twice found within the bowel. Probably such neoplasms were overlooked in some of the cases with undetermined etiology.

Among those who passed sloughs of bowel the frequency of tuberculosis is impressive. A perforated ulcer in the intussusceptum may serve partially to re-establish continuity of the intestinal canal. Meanwhile, pressure necrosis amputates the inner cylinders and auto-anastomosis proceeds. Often the sequel is hemorrhage, perforation, or cicatricial stenosis.

The symptoms of intussusception resemble the classical manifestations of parturition and baffles differential diagnosis.

At operation the moot question is: What shall be done about the pregnancy? The surgeon should aim primarily to give the mother the best chance of recovery. If the uterus will receive any treatment, this must be the first step. With reference to lowering the maternal mortality, prompt abdominal exploration will be still more influential.

Death of the mother is mentioned in 15 reports, her recovery after operation in two. Three patients who passed necrotic segments of intestine reached term. Early publication of these emotional narratives goes no farther than the delivery, except in one instance where the mother became a semi-invalid.

The fetus perished in 7 of the 12 cases pertaining to pregnancy, and in 1 of 2 cases of intussusception during labor. In the puerperium, of course, maternal ileus has no direct bearing upon the infant.



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# PRINCIPLES OF PNEUMOLYSIS

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THE intrapleural severance of adhesions to close cavities introduced by Jacobaeus in 1913 is a surgical procedure of increasing importance in the treatment of pulmonary tuberculosis. Its field of usefulness is steadily widening with the result that larger numbers of patients participate in the benefits resulting from effectual pneumothorax therapy, and the prognosis of advanced tuberculosis has been materially improved. Although the operation is still regarded by some as a dangerous and difficult one with limited indications and to be undertaken only after weighty consideration, recent developments of new and improved instruments with concomitant simplification of technique should make intrapleural pneumolysis a common procedure and one to be employed as a matter of choice wherever it can shorten convalescence, render open cases negative more quickly or simplify the pneumothorax treatment by eliminating the necessity for positive pressure refills and permit longer intervals between refills. The evolution of this operation thus parallels that of pneumothorax treatment itself in that the trend is to employ it early in the course of treatment and to widen its indications.

## INDICATIONS

The frequency with which the operation is thought to be indicated will vary with the experience judgment and enthusiasm of the individual physician. It will also vary with the type of patient placed under treatment as adhesions that are likely to interfere with a satisfactory collapse are naturally encountered more frequently in advanced cases. Figures given in the literature range from 2 to 80 per cent. My own experience leads me to believe that the operation is indicated in 20 to 30 per cent of pneumothorax patients in whom adhesions are demonstrable in the x-ray examination. These figures include some adhesions which would in time probably stretch sufficiently to permit closure of cavities, but surgical interference would permit an earlier and more probable return to health. The following experience will serve as an example.

**CASE 1.** D G white male 26 years of age was first given pneumothorax treatment for advanced tuberculosis

From the Henry Phipps Institute and Graduate Hospital of the University of Pennsylvania, Philadelphia.

of the left upper lobe with cavity formation and positive sputum on June 2 1932. An apical cord adhesion was encountered which prevented closure of the cavity. The adhesion however stretched continuously under the pressure of the induced pneumothorax and it was hoped that in time it would permit complete closure. By March 1933 9 months after the induction of the pneumothorax the adhesion had stretched to 9 centimeters. In the meantime however, the cavity had increased in size and now measured 4 by 3.5 centimeters. The patient developed a series of severe hemoptyses and there was an extension of the disease into the right or 'good' lung. It was therefore not thought wise to postpone surgical intervention longer and on March 30 1933 I severed the adhesion with the operating forceps thorascopically (Fig. 7) without difficulty. There was a mild postoperative reaction for a few days after which the cavity promptly closed. Bilateral pneumothorax was later induced to control the disease in the right lung. The patient's general condition has steadily improved and for the past 2½ years he has been working and self supporting. There has been no recurrence of hemoptysis. The sputum is persistently negative for tubercle bacilli.

A critical analysis of this case in the light of its history shows that a *laissez faire* management was in fact not without danger. Doubtless, the adhesion would have continued to stretch, and, given enough time, the cavity would probably have closed without surgical intervention. But meanwhile the disease was progressing in both lungs and hemoptysis had occurred, indicating the risk involved in delay. Moreover, the ease and safety with which the adhesion was eventually severed suggest that the patient might readily have been saved months of invalidism and considerable expense if pneumolysis had been undertaken much earlier in the course of his illness.

In addition to the recognized need to sever adhesions which mechanically prevent or delay the closure of cavities, other indications are now considered, even though the cavity be closed by the pneumothorax. This is particularly true of string or cord adhesions that extend from the lung to the chest wall in the upper third of the pleural cavity. A considerable number of these adhesions act as a strong counter pull to the force of the pneumothorax and not infrequently necessitate positive intrapleural pressures to maintain the collapse. The amount of air that can be given under such circumstances at any one time is limited and frequent refills become necessary. Furthermore, in order to maintain such a pneumothorax, one is forced to collapse considerably more of the healthy area of the lung than would

even after the most painstaking x-ray and fluoroscopic study, whether a given adhesion is or is not suitable for operation. As a general proposition, adhesions are usually more numerous and extensive, and the operation more difficult, than the preliminary x-ray studies suggest. In cases of doubt it is better to look into the chest with the diagnostic thoracoscope and study the mechanical problem directly. Thus with but slight inconvenience to the patient, one can convince oneself that the adhesion is inseparable or on the other hand that a complete collapse can be obtained in cases previously not considered perfectly suitable. One must also keep in mind that as we accumulate more and more experience, and mechanical difficulties are surmounted with the development of new and better instruments, many adhesions that prove troublesome today will be a matter of routine surgery in the future.

#### PRINCIPLES OF PROCEDURE

If intrapleural pneumolysis is to be carried out, obviously there must be a sufficiently large pneumothorax space to permit safe instrumentation, and the adhesion must be one that can be severed safely. In addition certain principles of procedure or working rules must be kept in mind.

The first is not to attempt surgery too soon. At least 2 to 3 months should elapse after pneumothorax therapy has been instituted before undertaking this operation, even though it becomes apparent that the adhesion will have to be severed. There are several advantages in postponing surgery for this period of time. The more the adhesion is permitted to stretch the simpler will the mechanical problem become. It is obvious that the longer the adhesion, and consequently the greater the space between the lung and the chest wall, the less the danger of cautery injury. Another advantage is the avoidance of pleural reaction. During the first few months of pneumothorax treatment, the pleura is quite sensitive. It is mainly during this period that troublesome effusions occur. It is also during this period that the absorptive power of the pleura for air is greatest, requiring refills at frequent intervals. To operate during this sensitive stage is to invite pleural reaction and probable loss of pleural space. Another important reason for postponing surgery during the early months of pneumothorax is to permit time to determine if certain adhesions will stretch sufficiently to be of little or no mechanical importance with no clear cut indication for surgery, thus avoiding unnecessary surgical pneumolysis follows from the first, and this is not to

otherwise be necessary with the danger that the increases work forced upon the contralateral lung may activate a quiescent lesion. The severance of such adhesions is usually not difficult and as a rule is not followed by any serious complications and in most instances is preferable to the maintenance of a difficult pneumothorax. With the lung released the intrapleural pressure is reduced, a better selective collapse results, and the interval of refill can often be lengthened. This is good treatment and in itself warrants surgical interference. In addition to these advantages the severance of some adhesions will result in the correction of a mediastinal hernia or the elimination of aching sensation of which some patients complain in the region of stretched adhesions. Some operators even advocate the severance of adhesions as a general procedure on the ground that the resulting increase in collapse insures a more solid fibrosis and a safer healed lesion in the end. More conservative opinion, however, would avoid surgery in the absence of more definite indications

#### THE OPERABILITY OF ADHESIONS

The easiest and safest adhesions to sever are strings and cords. Bands come next. The most difficult and dangerous are apical caps where the entire apex of the lung is adherent to the chest wall. Unfortunately apical caps adhesions account for at least 50 per cent of all uncollapsed cavities. They often overlie stiff walled cavities that have existed for years with the partial pleura or cap making up part of the cavity wall. The danger of emptying, of marked pleural reaction, or spontaneous pneumothorax is definitely increased if this operation is attempted in such cases. Even if the adhesion can be severed successfully the operation must be done in stages, and success is achieved only after expenditure of much time and effort. Some of these patients are better suited for thoracoplasty or external pneumolysis and plombage. However, if the latter are contra-indicated an attempt at closure of such cavities should be made with internal pneumolysis, provided the mechanical difficulties involved are recognized and the operator is skilled in the proper surgical procedure. Sometimes the operator is rewarded with a brilliant result in an apparently hopeless case (Figs 1, 2, 3, 4). Alveolized adhesions may consist of any combination of strings, cords, bands, folds, and apical caps. Every case is a problem in itself and the operability will depend largely on the individual problem encountered.

In this connection it should be emphasized that it is not always possible to determine beforehand

wait too long. Unnecessary delay should be avoided as conditions may not always remain favorable. Adhesions have been known to change their anatomical appearance and, instead of stretching and becoming narrower and easier to handle may become thicker and wider with shortening of the adhesion and consequent expansion of the lung. Prolonged waiting for adhesions to stretch sufficiently to permit closure of cavities cannot be considered good judgment and is unwarranted in the light of accumulating experience. A good working rule is to fix, to 6 months as the upper limit to postpone surgical interference. Adhesions are usually stretched all they can reasonably stretch within this time, and nothing further will be gained in the average case.

A third principle is the fact that it is usually not necessary to sever all adhesions in order to close a cavity completely and not always necessary to cut through all of one adhesion. Adhesions often yield surprisingly, once they have been weakened sufficiently by electrosurgery. When the points of greatest tension have been released properly spaced pneumothorax refills will in time accomplish the desired result (Figs. 1, 2, 3, 4).

A fourth working rule is not to do too much at one cutting. Postoperative reactions and consequent hospitalization in many cases can be reduced by performing the operation in stages. The same principles hold here as in thoracoplasty. Tuberculous patients can often stand considerable surgery if too much is not done at one time.

A fifth working rule is to support the contralateral lung with a phrenic nerve operation or a partial pneumothorax if there is active disease in the better lung before undertaking intrapleural pneumolysis in complicated cases. If this precaution is not taken there is grave danger of a serious spread of the disease in the contralateral lung following the pneumolysis. This may not only mean prolonged convalescence but a lost opportunity for recovery.

#### COMPLICATIONS

Like all surgical procedures intrapleural pneumolysis has its dangers and complications. The risk is naturally greater with the more troublesome adhesions. These dangers and complications can be materially reduced or minimized by the adoption of the single cannula technique, the use of electrosurgery instead of galvanocautery, the possession of the necessary skill and judgment on the part of the operator and efficient postoperative care. Operative mortality is low, less than 1 per cent, and usually results from spontaneous pneumothorax either from cauterized

lung or the tearing of a partially severed adhesion following injudicious postoperative pneumothorax refills. Other complications are severe pleural reactions, tuberculous empyema, hemorrhage and loss of pneumothorax space. Pleural reactions can be avoided by not doing too much at one time, by the use of electrosurgery instead of galvanocautery, and by postponing surgical intervention for at least 2 to 3 months after the pneumothorax has been instituted. Tuberculous empyema is as a rule not a serious complication and in time clears up under proper treatment. It can not always be avoided as some adhesions harbor tubercles (Fig. 5). Its probability should not serve as a contra indication. Hemorrhage can be avoided or controlled by proper operative technique. The same is true of loss of pneumothorax space. Subcutaneous emphysema is not an important complication, is never serious, and needs no treatment.

#### TECHNIQUE

A few words on operative technique are desirable. In the original Jacobaeus technique which with certain modifications is still practiced by most operators the thoracoscope is introduced in the pleural cavity through one cannula and the cutting electrode through another cannula at another point in the chest wall. The cautery must thus be manipulated at a distance from the point of vision. The complexity of this procedure has deterred many from undertaking the operation. It has also limited the usefulness of the procedure to certain types of adhesions. The time of the operation is also unduly prolonged.

In the author's single cannula technique all instrumentation is through a single opening into

Fig. 1. Bilateral advanced tuberculosis with cavities in both apices. Pneumothorax therapy established on left. The large cavity in the left upper lung is adherent over a wide area. A typical example of an apical cap adhesion.

Fig. 2. Semidiagrammatic illustration of apical cap adhesion and small cord as seen at time of operation through thoracoscope. The apical cap makes up part of the cavity wall and in most instances cannot be severed. In this instance the free margin of the apical cap could be severed for a distance of one half inch. The cord adhesion was also severed.

Fig. 3. Shortly after severance of the cord and the free margin of the apical cap adhesion. The subsequent pneumothorax refills gradually stretched the remainder of the cap adhesion and permitted complete closure of the cavity (Fig. 4).

Fig. 4. The large cavity in the left upper lobe is now completely closed. This is an excellent example of the value of partial pneumolysis and well illustrates the principle that it is not necessary to sever all adhesions nor all of one adhesion to close cavities. Adherence to this rule will often yield surprising results in otherwise hopeless cases.

Fig. 3

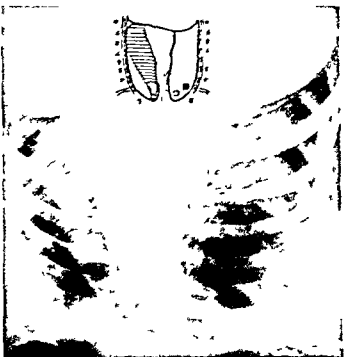


Fig. 4

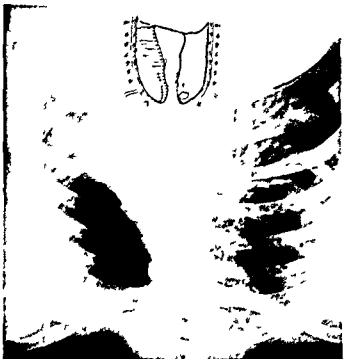


Fig. 1

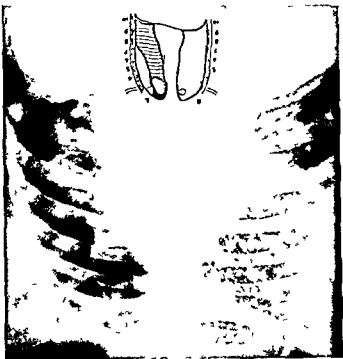


Fig. 2

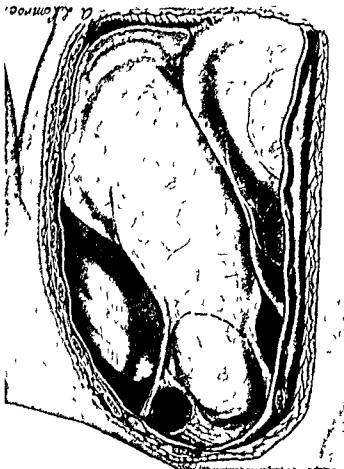




Fig 5 Microscopic section of a caseous tuberculous area in a small cord adhesion studied by Dr E. K. Long. Tuberculous empyema may follow the severance of such an adhesion.

the chest, usually through the second anterior interspace. The telescope, light, and electrode are combined in one simple instrument. Consequently there is greater facility in reaching and severing adhesions and a greater degree of safety in performing the operation. As a result an ineffectual collapse can be made effectual more readily and accordingly use of this operation has been widened to include many cases formerly considered unsuitable. The original instruments have been steadily improved and new instruments added to meet special problems in technique so that a complete set is now available to meet almost every mechanical problem. The most important single instrument still remains the Cutler operating forceps thoracoscope, which can be employed in more than 80 per cent of all operable adhesions (Fig 6). This instrument enables the operator to grasp the adhesion within the jaws of

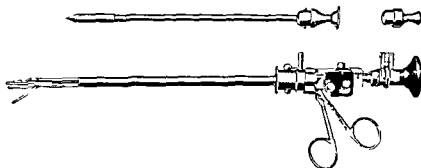


Fig 6 The Cutler operating forceps thoracoscope. This instrument is the basis of the author's single cannula technique and is suitable for 80 per cent of operable adhesions. It has materially simplified the operation, widened its usefulness, and increased the safety factor.

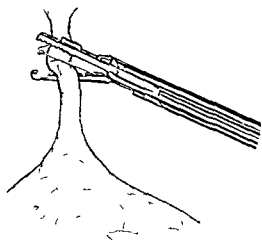


Fig 7 Cord adhesion within grasp of jaws of forceps thoracoscope. The adhesion is held firmly in plain view until it is thoroughly coagulated and severed.

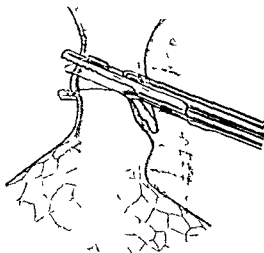


Fig 8 A wide band adhesion within grasp of the forceps jaws. Large difficult adhesions can be handled with ease and safety by severing the adhesions in small bites.



# SPINAL FIXATION ULTIMATE RESULTS IN FOUR CASES WITH POTT'S DISEASE, VERIFIED AT A SECONDARY OPERATION

W ACKERMANN, M D New York, New York

**I**N THE period January, 1925, to September 1929 about 120 spinal fixations for Pott's disease were performed. Three of the patients were subjected to secondary operation, the reasons for which are given in this article. A fourth patient who also had a secondary operation, had the primary operation at the Ruptured and Crippled Hospital in New York, according to Albee's method. In all Sea View Hospital cases, however patients were operated upon according to Hibbs' method, which is briefly described as follows:

A median incision is made directly over the tips of the spinous processes, it passes through the skin fascia the supraspinous ligaments and periosteum and extends somewhat above and below the immediately involved region. The incision divides the periosteum in the median line over the spinous processes. The periosteum is incised over both the upper and lower prominent posterior margins of the spinous processes (that is throughout their length) as well as along the upper and lower borders of the laminae after which the individual sheets of periosteum are stripped back with a periosteal elevator, to the bases of their respective transverse processes. Bleeding is controlled during this state by packing with gauze. The lateral articular processes at the bases of the transverse processes are exposed and curetted for the purpose of contributing arthrodesis to the ankylosis of the periosteal osseous parts. The spinous processes are then partially fractured, transversely near their bases, by bone pliers or by chisel after which the partially freed but still connected spinal tips are transposed downward in such manner that the partly severed base of each remains in contact with its own base and its tip with the side of the partly severed base next below. From the posterior surfaces and borders of the laminae which have been freed of periosteum earlier in the operation small platelets of bone are partially detached by chisel but are left hinged at their opposite ends, and are then broken backward

and so disposed as to overlap the raw bony surface left upon the laminae next below by turning down a platelet of its outer surface. The space between them is bridged. Finally, the temporarily, outwardly displaced small sheets of periosteum, together with the medially divided supraspinous ligaments, are brought together about the rearranged bony fragments and sutured tube like over them, by buried chromic catgut. The fascia and skin are then united by interrupted or continuous suturing and a dressing is applied. A steel brace immobilizes the spine without pressure over the wound. I have seen about a hundred cases with good results without any brace immobilization. The patient remains in bed from 8 to 10 weeks, sits up for 4 weeks, and begins walking at the end of 12 weeks. The brace is worn continuously from the beginning until a month after walking is resumed after which it is discontinued for a part of each day and then gradually entirely discontinued.

In the fourth case of this series (for the first operation only) Albee's method was employed.

In this procedure the involved weakened region of the spine is stiffened and solidified by a technique which also amounts to a spinal fusion as in Hibbs' method but which is accomplished by implanting a bone graft taken from the tibia, between the medially split spinous processes of the portion of the spinal column involved.

## CASE REPORTS

**CASE 1.** W. H. a boy aged 18 years at the time of admission to the hospital. He had had infantile paralysis in infancy but no serious illness in adult life. Fifteen months prior to admission an abscess appeared on the back and was followed by severe pain gradually a sensation of anesthesia developed throughout the lower extremities. He was treated by chiropractors and several physicians and as his lower extremities became completely paralyzed he continued treatments at various clinics with out result.

August 3, 1936 he entered the Sea View Hospital and the following diagnosis was made:

Chronic pulmonary tuberculosis (inactive) valvular lesion. Pott's disease of dorsal spine involving sixth dorsal to ninth dorsal vertebrae inclusive with abscess and Brown Séquard's paralysis with partial incontinence of alva and urine. General condition of patient was fair. His first



received treatment by traction without success. Hibbs' fusion August 13, 1926, extended from the fourth dorsal to the eleventh dorsal vertebrae, inclusive. His condition did not improve, however, after the operation, and the paraplegia became more spastic. It was then decided to perform a laminectomy, which was carried out on December 17, 1926. During this operation the opportunity was taken to expose the previously fused area, and there could be no doubt of the accomplished fusion which had taken place. After this operation paraplegia seemed to be improving for some time as patient noticed some sensation in his lower extremities. As time went on, however, the general condition of patient became worse—developed, in addition, a tuberculosis of his right hip, as indicated in Figure 1. Roentgenograms of the spine taken at the same time, show an increase in size of the abscess shadow. The destruction of the spine also seemed to have progressed (sixth to tenth dorsal vertebrae) as indicated in Figure 2. A general amyloidosis with anasarca developed and on May 27, 1928 patient died.

CASE 2. M. A. young woman (colored) aged 30 years at the time of admission July 27, 1927 gave a definite history of having had pain in her back (dorsal region) since June, 1926, the condition gradually becoming worse and more painful, no complaints to the respiratory tract. A diagnosis of tuberculosis of spine (Pott's disease with abscess) and chronic pulmonary tuberculosis (inactive) was made and these facts were verified by roentgenograms (Figs 3 and 4) which show an arching kyphosis in lower part of dorsal spine an extensive destruction of the ninth and a partial destruction of lower end of the eighth dorsal vertebra. An abscess shadow is seen extending from the seventh to the twelfth dorsal vertebra. As pulmonary findings did not disclose any definite activity, a Hibbs' fusion was performed August 23, 1927, from the sixth to the twelfth dorsal vertebrae, inclusive. The postoperative



Fig. 1 Case 1

course was satisfactory until about the end of October 1927, at which time the patient developed spasm of both legs, positive Babinski, and clonus. These symptoms were gradually getting worse and November 10, a complete paraplegia developed. A neurological examination disclosed a lesion in the cord at the level of eighth dorsal, double Babinski clonus, and absent abdominal reflexes. Roentgenograms taken at that time, as compared with previous ones, disclosed a greater density of spine shadow



Fig. 2 Case 1



Fig. 3 Case 2



Fig. 4 Case 2

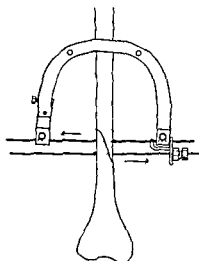


Fig 1 Internal fixation by means of opposing beaded wires. Lateral pressure and counterpressure maintained by means of Kirschner bow, extension arm and tightening bolt.

lined in shape, thus affording a larger bearing surface on the side of the bead facing the drilling point, while the conical proximal portion facilitates removal. A somewhat flattened, diamond shaped drilling point with sharpened cutting edges, has been found very effective as it penetrates readily through the heavy bones of the lower extremity (Fig 3). This important detail has been overlooked by most instrument makers in preparing their Kirschner wires, with the result that considerable difficulty is frequently experienced when drilling the heavier bones.

The wires are inserted by means of a slightly modified Kirschner drill, the holes in the sliding wire guide being enlarged just sufficiently to

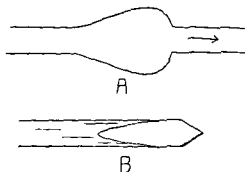


Fig 3 Detail of beaded wire. A Shape of bead. B Flattened drilling point with double cutting edge.

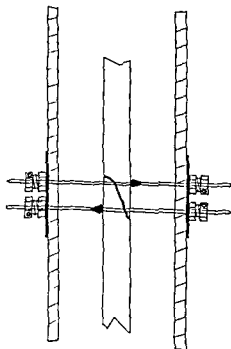


Fig 2 Method of fixation in plaster of Paris after cast has hardened. Tightening bolts applied over thin pressure plates.

permit free passage of the beaded portion of the wire. This modified drill is equally suitable for introducing the conventional wires.

During our early work the lateral traction and countertraction was applied to the beaded wires by means of two Kirschner bows. It has been found that when the opposing beaded wires have been placed and a tightening bow has been applied to one of them, sufficient opposing pull can be transmitted to the other beaded wire by means of an extension device which is slipped over the appropriate end of the bow. The distal end of the second wire fits into a slot in the extension accessory and lateral pressure is applied by means of our tightening bolt (Fig 1).

#### SUMMARY

A method of internal fixation for that group of spiral and oblique fractures which require open reduction to obtain satisfactory reduction is described. Experience with a small series of cases treated by this method leads us to conclude that its application is simple, the fixation adequate, and normal healing processes are favored.

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## ENDOCRINE THERAPY IN GYNECOLOGY

RECENT developments in the treatment of young women with functional menstrual irregularities seem encouraging from the standpoint of the results which have been obtained.

For some years cases of this type have been grouped under the heading of ovarian dysfunction, either of the amenorrheic or metrorrhagic type. While the results of treatment in such cases have been highly satisfactory, approximately two-thirds of the patients in each group experiencing a return of what they themselves considered to be a normal menstrual cycle, since 1933 an even greater percentage of improvement has been obtained in such cases, and particularly in those of the metrorrhagic type. Inasmuch as since 1933 only the active hormone preparations have been added to the other means of treatment, some of this improvement must be attributed to hormone therapy.

The principle reason for this improvement, however, would seem to be the recent advances in diagnostic methods which enables clinicians to determine just which one of the glands involved in a dysfunction is at fault. Determinations of the amounts of estrin and prolan in the blood and urine and biopsy of specimens and curettings of endometrium have enabled them to determine whether the failure lies primarily in the ovaries, the estrogenic or the luteal hormones being involved, or whether such failure is secondary to failure of the anterior lobe of the pituitary gland to produce the gonadotropic hormone. But it is probably only since such facts have become known that it has been possible to use the active hormone preparations as well as all other therapeutic measures intelligently. Evidently there is no question in the minds of clinicians who have been fortunate enough to have at their disposal a laboratory equipped to make determinations of estrin and prolan in the blood or urine of patients with functional disturbances of the reproductive organs but that it is possible to decide from such studies whether the ovaries are secreting estrogenic hormone in nearly normal amounts and whether the anterior lobe of the pituitary is secreting prolan, the gonadotropic hormone, in nearly normal or in excess amounts. Clinicians owe a great debt of gratitude to the histologists and pathologists who are steadily furnishing them information regarding the phases of the endometrium during the normal and abnormal menstrual cycles. The latter seem to be in accord that an endometrium which is in the persistent proliferative phase, with or without evidences of cystic degeneration, is the result of the action of

estrogenic hormone only, and that when there is evidence of glandular secretion and differentiation, luteal hormone must have acted on it as well. When the endometrium is atrophic, one may expect both ovarian hormones to be absent in the circulation, or at least to be present in amounts insufficient to effect any change in it and that this type of endometrium may be associated with both amenorrhea and metrorrhagia is not as strange as it may seem. As yet we do not know what initiates menstrual bleeding in the normal cycle. It may be an agent entirely apart from the ovaries. We must, therefore, in order to make a diagnosis, continue to use every means at our disposal, such as careful taking of the history, thorough physical examination (with special reference to the development of the breasts and external genitalia to the size of the ovaries and uterus including examination of the ocular fundi and visual fields and roentgenological examination of the sella turcica), and determinations of the basal metabolic rate.

With the help of the newer diagnostic aids, the large group of cases of menstrual dysfunction can now be divided into those of primary pituitary failure and those of primary ovarian failure. Young women with menstrual irregularities due to pituitary failure complain chiefly of the menstrual irregularity and, if married, of sterility. They are inclined to be obese and to have metabolic rates lower than normal. Prolan is not demonstrable in their urine with the technique for normal amounts and estrin is lower than normal or not demonstrable at all. Treatment in these cases has for some years consisted of a high vitamin reduction diet and thyroid medication sufficient to hold the metabolic rate around  $-5$ , and, in the severer cases, the addition of low dosage roentgen irradiation of the pituitary and ovaries. It has recently been possible in

some of these cases to re-establish the menses, when the amenorrhea has not been of more than 6 months' duration, by giving single large doses of estrogenic hormone, such as 10,000 International units to the cubic centimeter (Progynon B). Two or three such doses may have to be given at intervals of 5 or 6 days, allowing time for the period to ensue between intervals. After spacing such dosage so that a period comes regularly for 3 months, the cycle will often go on of itself. Single large doses of estrogenic hormone evidently stimulate the pituitary by suddenly changing the level of estrin. The ovaries are presumably normal in these cases and the only thing that is needed is to get the pituitary motor going.

Young women who have ovarian failure are usually of normal weight and have nearly normal metabolic rates. In addition to the menstrual irregularity and the sterility they complain of many symptoms associated with their irregular, scanty menses, and often also of vasomotor disturbances such as hot flashes during periods of amenorrhea. Soreness of the breasts, pelvic pain with nausea and vomiting, a migrainous type of headache, aching in the lower part of the back and thighs, increased nervous irritability and such skin manifestations as acne, urticaria and angioneurotic edema, may antedate or accompany menstruation. Values for estrin in these cases vary greatly, but only in cases of complete ovarian failure is estrin not demonstrable at some time, prolان is always normal or in excess, depending on the degree of ovarian failure. In one group of cases recently studied in which the values for estrin reached higher peaks than normal, prolان was still found in excess. The symptoms are evidently dependent on the proportionate excess of prolان, as young women with pituitary failure, even to permanent cessation of the menses in

hormone and try to improve the function of the pituitary and ovaries, if necessary, by other means

Perhaps those patients who are most grateful for the advent of these active hormone preparations are the ones who are suffering from the vasomotor disturbances of the menopause and from the symptoms associated with atrophy of the genitals consequent to ovarian failure. Treatment of the vasomotor disturbances has been put on a much more logical basis by means of determinations of the amount of estrin and prolan in the blood and urine. All that is really necessary is to determine if excess prolan is present in the urine. If it is, the patients' symptoms can be explained on an endocrine basis as being attributable to excessive pituitary function, and they will subside when estrogenic hormone is given in amounts sufficient to suppress this pituitary function. When women complain of the same subjective symptoms long after the cessation of their menses, or in cases of women with bizarre complaints, the test for excess prolan has been very helpful. In only those cases in which a positive test can be obtained on repeated examinations, are patients helped by hormone therapy.

Repeated studies of vaginal smears in order to note the full effect of estrin in the vagina, according to the method of Papancicolaou, helps greatly in assuring both physician and patient that sufficient of the hormone is being given to bring about the full beneficial effect of such treatment. Hot flashes will subside, often with only small amounts of hormone, but it is not until the full effect of estrin is obtained and until it is maintained for a time that the patient regains that sense of well being consistent with a normal mental state. This same estrin effect in the vagina should be obtained in treating patients with atrophic or senile vaginitis. It is surprising how soon

early life, have none of the complaints which have been mentioned

Before the advent of the active hormone preparations, treatment in this group of cases of ovarian failure consisted only of some form of heat or low dosage roentgen method of improving ovarian circulation. Some form of heat or low dosage medical therapy over the ovaries, and thyroid medication, if there was indication for its use. Now, in addition to this treatment, symptoms can be relieved by giving such patients estrogenic hormone. One hormone preparation, Collip's emmenin complex, made from the placenta, has been very helpful in regulating, and even establishing, the menses in these cases when the amenorrhea has not been of more than 5 months' duration, in addition, it has relieved the associated symptoms. In giving estrogenic hormone to these young women it would seem best always to keep in mind the normal physiologic estrin curve and to vary the dosage to simulate this, interrupting the dosage at the end of 3 weeks for 6 or 7 days in order to allow menstruation to come on if it will.

In metrorrhagic dysfunction it is now also possible to differentiate pituitary from ovarian failure and to direct therapy more rationally. Regardless of this, in the majority of these cases it is the function of the corpus luteum and its failure to secrete luteal hormone, that is at fault, and since we now have an active luteal hormone to supply, bleeding can often be controlled in this way, especially in younger women. Anterior pituitary-like preparations of pregnant urine are being given with a view to producing luteinization of the ovaries, thereby indirectly controlling the bleeding. For young girls this treatment should be used with great caution as a great increase in the size of the ovaries has been reported following its use. It would seem best to supply active luteal

an associated inflammation will subside when the estrin effect is maintained for a time. If *Trichomonas* are present, local treatment is also necessary to rid the vagina of the parasites.

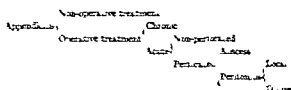
Estrogenic hormone therapy is very valuable in the treatment of any type of vaginitis, of childhood or old age, but it must be remembered that it will not cure cervicitis. Vulvar pruritus, associated with atrophic changes, can often be controlled with estrogenic hormone if an endocrine factor is the chief causal one in the trouble.

Warnings have been sounded recently about the carcinogenic properties of estrogenic hormone. It would seem that the estrogenic hormone is limited in its action to the tissues in which it induces processes of growth during the normal sexual cycle, such as the uterus, vagina, and breasts. It would also seem that the hormone must be present in proportionately large amounts and act over a long period of time, and that it can probably only then induce malignant changes in the presence of the unknown cancer factor. It would certainly not seem advisable to treat women with estrogenic hormone who have had cancer of the breasts or pelvic structures, or perhaps those also whose family history shows many cases of cancer. When treatment must be continued for some time as in the case of vasomotor disturbances, clinicians seem to agree that it is better to interrupt such treatment occasionally in order to allow the uterine endometrium to return to its interval phase. When treatment is carried on in this manner and amounts of hormone are used which are sufficient only to get the same follicular or estrin effect in the vagina that occurs just prior to ovulation, it would seem as if the women who present the usual indications for therapy should have the benefit of it.

DELLA G. DRIFT

## MORTALITY RATE OF APPENDICITIS

TO ENHANCE the value of 'statistics' and to simplify the study of mortality rates, it might be advisable to subdivide the subject of appendicitis as follows:



Results of non-operative treatment would be of interest as controls, but because of uncertainty in diagnosis, the results are of necessity unreliable. 'Chronic' appendicitis and acute appendicitis, non-perforated and perforated with abscess, if treated according to generally accepted standards, should, and do have a very low mortality rate. The occasional deaths are due, chiefly, to the ever present possibility of accident. This will leave for analysis only the perforated cases, with local or diffuse peritonitis. Distinction between local and diffuse is at times difficult, uncertain and may depend largely upon the 'personal equation' of the operator.

The establishment of certain identifying characteristics or criteria, determinable at the time of operation that would allow uniform recognition and segregation of these two types of the disease would be of material aid in evaluation of results. And it would seem that this might be practically accomplished by co-operation between committees appointed by the various representative surgical societies.

As one may with justification, anticipate recovery after proper standardized treatment in perforated cases with localized peritonitis, the acceptance of such a definite distinction would (because of the low mortality rate) per-

and the additional exclusion of such cases in a consideration of the question of high mortality rate in appendicitis

After these exclusions—of chronic, acute, non-perforated, and perforated with abscess—which the mortality rate is high (24 to 40 per cent) and the treatment of which calls loudly for improvement

The largely theoretical, and more or less visionary, attempt to differentiate between "diffuse" and "general" peritonitis is not practicable and promotes confusion and misunderstanding. Therefore, it seems that the question changes from the mortality rate of appendicitis to that of peritonitis. If considered, as is peritonitis, following other causes, such as, gunshot wound, rupture of peptic ulcer, or perforation of sigmoid diver-

ticular, the resultant simplification might enhance the value of "statistics," which may, it has been said, "be made to prove anything even the truth"

Therefore, it would seem logical in the treatment of perforative appendicitis with diffuse peritonitis to endeavor to prevent distention and ileus and death, by prophylactic intestinal decompression and enterostomy at the time of appendectomy

A cursory review of recent literature seems to indicate that such a principle of treatment is increasing in popularity

F. GREGORY CONNELL





James J. Jera





The Harvard Medical School had the benefit of his experience and logical mind from 1901 to 1932. He was appointed assistant in surgery in 1901, instructor in surgery in 1905, and assistant professor in surgery in 1910, the latter position being held until his retirement from active service at the Massachusetts General Hospital in 1932. He was a clear thinker and an inspiring teacher, much beloved by all his students.

He served as a member of the Cancer Commission of Harvard University for many years and was active in the organization of the Collis P. Huntington Memorial Hospital. He was appointed surgeon in chief of this institution in 1915 and held this position for several years, retiring as a member of the consulting staff. Always interested in the advancement of medical service, particularly pertaining to cancer, he was the logical person to co-operate with the late George H. Bigelow, then Commissioner of Public Health, in the organization of the Massachusetts State Hospital for the Treatment of Cancer at Pondville. The success of this venture is now well recognized.

In March, 1915, he went to France with the first "Harvard Unit" as surgeon and executive officer, serving three months in the American Ambulance at Neuilly-sur-Seine. Two articles which he wrote following this experience were of great help to the medical profession in this country just prior to our entry into the war. Being in the Naval Reserve Corps, he was ordered to active duty in the United States Navy on July 28, 1917, as chief of the surgical service of the Chelsea Naval Hospital. He began this service with the rank of lieutenant, junior grade, and rose to the rank of commander, U. S. N. R. F., Class 4, being relieved of active duty on February 3, 1919.

He was an active worker in the Massachusetts Medical Society and a contributor for many years, and was president of this organization from 1929 to 1931. It was during this time that he was able to stress his ideas on adequate medical care for all. He met with great opposition due to the feeling that many of his idealistic tendencies along this line pointed toward state medicine or government control. All through this his bitterest opponents remained his loyal and staunch admirers. They respected his integrity, his seriousness of purpose, his unselfish attitude toward suffering humanity in general. This characteristic was frequently demonstrated not only among the poor but among the well-to-do, he having the sincere feeling that a just fee for professional services was really a very modest one regardless of the financial status of the patient.

For a great many years he had been a staunch supporter of the American College of Surgeons, serving this organization on the Board of Governors from 1923 to 1925, as Regent from 1924 to 1937. During this latter time, he was a member of the executive committee. He was president of the College in 1934-1935 and was vice-chairman of the Board of Regents and the executive committee at the time of his death. He contributed a great deal to the cancer

program of the College as well as to its other routine activities. No amount of time or self sacrifice seemed to be too much for him to give to this institution. He has been a member of the consulting editorial staff of *SURGERY, GYNECOLOGY AND OBSTETRICS* since January, 1934.

He was a director of the Society for the Control of Cancer for many years and was president of this body from 1936 to 1937. He was an active member of the American Association for Cancer Research, the American Academy of Arts and Sciences, the American Surgical Association, the Society of Clinical Surgery, the New England Surgical Society, and the Boston Surgical Society, having served as president of this organization from 1928 to 1930.

Dr. Greenough made over sixty contributions to the medical literature. Over three quarters of these were on some phase of malignant disease. He leaves an unfinished monograph on the subject. In 1936, he was appointed a member of the Board of Managers of the Memorial Hospital for the Treatment of Cancer and Allied Diseases in New York City and was devoting a great deal of time to this new appointment when his last illness began. At the request of Miss Frances Perkins, he accepted an appointment on the Medical Advisory Committee on Social Security and devoted a great deal of time and thought to the problems involved.

In spite of a strenuously useful life, devoted to humanity, this energetic, dynamic individual found many hours to devote to his family and friends. He loved the great outdoors and whenever possible would snatch a few days, retiring with his family to the interior of Quebec where for generations they have controlled a large isolated tract of territory. He built here a comfortable lodge and although the chief object of these visits was relaxation, he undoubtedly turned out many of his excellent articles for the medical press while in this environment. He was an ardent fly fisherman, and from this sport derived much happiness. He was a most agreeable, witty, calm but gay person, his companionship being much sought after by a very large group of friends. One of his chief sources of pleasure was his association with members of the St. Botolph Club and he was president of this club when he died.

"Bob" will be greatly missed. For humanity's sake, we are thankful for his long and useful life, for our own, to have known him well. We know that he would not have elected any other departure than one which came to end abruptly his unusually active career.

ARTHUR W. ALLEN



The Literary Fund of the State of Virginia granted the struggling institution a loan of five thousand dollars and still other funds were obtained by subscriptions from Winchester and the surrounding country. With this rather large sum (for those days) a building of appropriate design was erected and equipped. This structure contained it is related, two lecture rooms, a surgical amphitheater with overhead daylight lighting, a dissecting room, a laboratory, and several offices. As far as the writer has been able to determine there were no facilities provided for the postoperative care of those patients who went under the knife in the glass domed operating room and, as there was no hospital in Winchester at this time, it remains somewhat of a mystery as to what was done with the surgical cases after operation.

The faculty of the College at the time of its revival consisted of the aforementioned Dr. Hugh McGuire, professor of surgery, Dr. J. Phillip Smith, professor of the practice of medicine, Dr. William Bradford, professor of chemistry and materia medica, Dr. J. H. Straith, professor of obstetrics and diseases of women and children, and Dr. Daniel Conrad, dean and professor of anatomy and physiology. In later years Dr. Bradford was succeeded by Dr. Bushrod Taylor and Dr. Conrad by Dr. J. William Walls. With the exception of the chair of operative surgery and surgical anatomy which was held for 3 years by Dr. Hunter McGuire, the faculty remained the same until the final closing of the college in 1861.

This faculty showed a great deal of foresight in the matter of teaching the principles of medicine and put into effect some radical and far reaching reforms in the work of educating the medical student of that day. A number of these principles were recommendations of the American Medical Association and other medical organizations of the day, but many reforms in the teaching of medicine were instituted on its own initiative.

The system of medical teaching which was then popular throughout America involved a session of 3 to 5 months in which the student was attending lecture upon lecture from early morning until sundown. The late afternoon and evening were used for dissection of cadavers and other laboratory work. Just when the student was supposed to study was not accounted for by the usual medical school of that day as far as this writer can determine. Two sessions were usually required for graduation although the second year's work was merely a repetition of the work of the first year. Another incongruous fact which has come to light is that it was the custom for the student to begin the study of anatomy and surgery on the same day.

The school in Winchester, however, feeling that such a curriculum was but ill suited to teach the neophyte the art and science of the profession decided, at the reorganization of the college, to have a session of 8 months duration so arranged that there were usually two and never more than three lec-

tures a day. This left the afternoons for dissection and other laboratory work and the night for study, and the plan possessed the additional advantage of allowing the student some time for recreation.

Furthermore, the course was properly graded and the subjects taught in their proper sequence. Another advantage of this more modern method of training was that, during dissection hours, an instructor was always present, whereas in the older methods of teaching the students were left to themselves in the dissecting room and rarely saw an instructor.

There was some difficulty in obtaining cadavers for dissection and indeed this difficulty led indirectly to the final destruction of the college. However, in spite of this the students had ample material for anatomical study and a large number of wet and dry specimens were prepared. Chemistry was taught by lectures and illustrated by experiments performed by the instructor. In 1860 a course in microscopy was instituted and, although this was crude the student was made as familiar as was possible at that time with the rudiments of clinical microscopy, microscopic anatomy, and pathology.

Regular clinics were held in surgery and medicine and in addition in so far as it was possible the students had access to the private practice of the professors. Surgical operations were performed before the class and in the session of 1848-1849, records show that over 75 were done and included such a variety as cataract hernioplasty, amputations, repair of club foot and cleft palate, and others.

In 1861 the college determined to inaugurate a summer session in addition to the winter course and Dr. Hunter McGuire, who had been teaching in the New Orleans School of Medicine during the previous winter, returned to Winchester again to become a member of the faculty of the Medical College. His return brought the total number of professors at this time up to six. However, it was not to be for during the same month the state of Virginia seceded from the United States and, on April 1, 1861, the college ceased to exist. Many wounded soldiers were brought into Winchester during the war and the college building was used as a hospital until it was burned in March, 1862.

Probably the most distinguished name connected with the Winchester Medical College was that of Hunter Holmes McGuire, the son of Dr. Hugh McGuire. This is not the place to enumerate the honors that came to this man in after life but one point of historical interest should be related here. While medical director on General Jackson's staff Dr. McGuire established the principle of treating medical officers as non-combatants, allowing those of the enemy to remain with their wounded and to return to their command after these were cared for. From that time until the advent of the World War this humane principle was adopted by the entire civilized world as a principle of warfare.

There were 72 graduates of the Winchester Medical College from 1848 until 1861, although the exact

number of the students in the Winchester Medical College went to Harper's Ferry by train to witness the battle between Brown's forces and the United States Army detachment led by Colonel Robert Lee. On leaving the train in Harper's Ferry before it reached the station the students came across a dead body lying on the banks of the river, and always looking for material for dissection, they packed it in a box and shipped it back to Winchester. Papers found on the body after it arrived at the college proved it to be the body of Owen Brown, the son of John Brown. The body was prepared for dissection and used for teaching purposes.

Winchester changed hands between the forces of the North and the South some eighty times during the course of the war and at one time in 1862 was held by a Union army under the command of General Banks. Because the body of the son of John Brown had been dissected therein the college building was burned to the ground by order of General Banks. The equipment and all records of the college were destroyed and as the glow of the embers faded the Winchester Medical College passed into history.

Of the number of matriculates is not known. Graduates, 16 came from outside of Virginia, 5 being from Maryland, 3 from Pennsylvania, 2 from New York, 2 from Illinois, and 1 each from Iowa, Maine, Tennessee, and Ohio. Because of some modest financial support given the school by the state it bound itself to educate without compensation. 15 students unable to defray their own expenses.

As has been previously stated, the destruction of the college building and records was indirectly due to the difficulty which was encountered at times in securing material for dissection in the anatomical laboratory. In those days, if the students knew where they could get hold of a dead body not too long since departed from this mortal coil the body was obtained, whether by fair means or foul deponent saved it not.

It so happened that in October, 1859, John Brown for the purpose of freeing the slaves. One of Brown's sons was a member of a raiding band which attempted to seize control of a rifle works in Harper's Ferry. During this raid many of the raiding party were killed. Led on by the excitement of the time a



Yours faithfully

Ian MacLaren

Ian MacLaren was the pen name of the Reverend John Watson who wrote *The Doctor of the Old School* a short story masterpiece concerning Dr. William MacLure



# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

ing so large a subject in such a clear, concise manner  
To those interested in syphilis the book is worth  
reading

EDWARD A. OLIVER

**VOLUME II of Post graduate Surgery**, consisting  
of 1760 pages, is now at hand. As a whole the  
subject matter is exceptionally well presented. In  
some instances briefly somewhat handicaps the in-  
tention of the work, however, it must be conceded  
that the entire surgical field, if covered with any  
degree of completeness, would require many thou-  
sands of pages of text and would, most likely, defeat  
its own purpose. The presentation suffers for the  
purpose for which it was intended.

In Part VI, diseases of the head, spinal column,  
and the salivary glands are discussed in some 100  
pages. This is rather brief in comparison with the  
amount of space allocated to subjects in Volume I.  
However, the description of the surgical diseases of the  
head, the description of the surgical diseases of the  
brain is too brief, most of the space being devoted to  
treatment. The author apparently does not think  
highly of the intracranial use of hypertonic glucose  
solution in the treatment of brain injuries. This is  
contrary to the general conception of the American  
neurologic surgeon. The impression also is gained  
that little care is taken in the cosmetic results fol-  
lowing head surgery. The majority of neurologic  
surgeons in America stress, along with delicate  
handling of brain tissue, a neat closure of the scalp  
wound so as to prevent visible scarring as much as  
possible.

In the surgery of the neck, the most common  
diseases are goiter and tumors, the latter including  
enlargements of the lymph glands. No doubt it is  
difficult to give even a fairly complete description of  
all surgical lesions of the neck without devoting  
much space to the subject. However, thyroid disease  
is not given the relative attention that the condition  
deserves.

Part III, devoted to the diseases of the breast, is  
inadequate. Specific information about the com-  
bined radiologic and surgical treatment of carci-  
noma of the breast is lacking.

The section devoted to the thorax is well done  
Specific attention should be called to that portion  
on artificial pneumothorax. Since so much work  
has been done recently on mediastinal tumors, it  
might be suggested that 8 pages probably do not do  
justice to the subject.

Approximately 170 pages are devoted to an un-  
usually well done description of diseases of the

ESPECIALLY designed for physicians in gen-  
eral practice, public health workers, and medi-  
cal students, is the small, concise, and readable  
book on syphilis by Hinton. While there are many  
books on this subject suitable for dermatologists  
and syphilologists, there is a real need for one that  
will give a clear, simple, and relatively complete  
account of syphilis for those mentioned. This book,  
an attempt to meet the need, was written after a long  
experience with syphilis in the laboratory and in the  
clinics of the Boston Dispensary, in teaching at the  
Harvard Medical School, in the Wassermann Labo-  
ratory of the Peter Bent Brigham Hospital and in  
public health work for the Massachusetts Depart-  
ment of Public Health.

The volume is divided into 3 parts. Part I, The  
Manifestations of Syphilis, Part II, The Treatment  
of Syphilis, and Part III, an appendix which takes  
up in detail, The Hinton Test for Syphilis.

To one familiar with syphilis in all its manifesta-  
tions, the book is interesting and instructive. Par-  
ticularly because of its personal note, and one must  
admire the author's courage in many of the state-  
ments he makes throughout the text, some of which  
are at considerable variance with the opinions of the  
most authorities. For example, in speaking of the  
tertiary stage of syphilis without an antecedent pri-  
mary lesion or secondary rash, he says, "During  
coitus slightly infected seminal fluid of an asympto-  
matic syphilis infected 2 to 4 years seems to pro-  
duce this form of the disease more often than any  
other kind of exposure." Page 81, "The Hinton  
test usually persists for a lifetime in untreated late  
syphilis," while most of the current Wassermann  
tests and the less sensitive flocculation tests gradu-  
ally grow weaker and become negative in 5 to 10  
years in perhaps half the cases." Page 84, "Gummas  
may occur about the corners of the mouth or the  
lips themselves may be the seat of extensive gum-  
matous or sclerotic changes that lead to puckering  
and scarring." "Impairment of vision occasionally  
results from the asphenamaines." These and other  
similar statements are controversial and for that  
reason alone the book is not the best possible one for  
those unacquainted with the disease.

The book is well written. The chapters on syphilis  
and marriage, interpretation of tests, and treatment  
of syphilis are handled extremely well. One notes  
with surprise however that Dr. Hinton still recom-  
mends mercury both by mouth and by injection.  
Although one may differ with many of the author's  
views, nevertheless he is to be commended for cover-

female genital organs. The subject matter is well presented and the form tends to simplify reading and understanding especially from the student's point of view. It is interesting to note that the author is discussing the treatment of acute suppurative salpingitis states "In my opinion operation should in most instances be advised." Five reasons are given. This opinion is contrary to that of most American gynecologists. This section and the one following, which is devoted to the urinary system and the male genital organs, are the outstanding portions of the volume both as to space allocated and the thoroughness of the description. Special attention must be called to Chapter I of Part XI on

The Investigation of a Patient with Genito-Urinary Symptoms which compares favorably with a similar chapter in Volume I on The Investigation of a Case of Dyspepsia. The author apparently favors suprapubic prostatectomy to transurethral resection in the average case, limiting the use of the latter to prostatic fibrosis, prostatic bar and certain types of median lobe enlargement of the gland. Very little attention is given to tumors of the testicle, a subject which has attracted much attention in America and portions of continental Europe especially from a diagnostic viewpoint. These two sections represent good medical teaching in general they so clearly illustrate sound reasoning along properly directed lines of thought. Throughout these sections the material is exceptionally well arranged and a sequential line of thought is followed. Many illuminating illustrations are included which again exemplifies the often repeated expression that a good illustration is more instructive than several pages of text.

Part XII, devoted to the sympathetic nervous system is compact. The author covers considerable ground in the 103 pages allotted. An interesting section on the adrenal gland stresses the surgical pathology of the gland and the adrenogenital syndrome. The section devoted to the injection therapy for hernia hemorrhoids hydrocele and varicocele varicose veins and chronic gravitational ulcers of the leg is instructive.

In an interesting section on infections of the hand issue must be taken with the advice on the treatment of infection of the terminal pulp compartment. The author states "If tenderness is most marked over the pulp compartment it is permissible to wait for localization of pus." A few lines further along he states "In late cases as soon as the incision is made, the diaphysis of the terminal phalanx literally falls out of a pocket of pus." In earlier cases the onset of osteomyelitis may be prevented but this happy event is distinctly rare. This expresses an obvious incongruity. Kanavel called attention to this condition on page 29 of the first edition of his work on *Infections of the Hand* published in 1912 stating "The treatment of felons consists in immediate incision into the infected area." The same statement appears in the sixth and last edition published in 1933. Moreover he and his school have

stressed the importance of early drainage in terminal phalangeal infections so as to prevent osteomyelitis.

The final section is devoted to orthopedics however, its scope is limited to deformities of the feet disabilities of the knee joint, acute osteomyelitis, acute arthritis open or compound fractures, muscle and tendon injuries, and the peripheral nerves.

The illustrations are many and of exceptional descriptive quality. This volume is a good companion for Volume I. JOHN A. WOLFER.

AS SET down in the preface, the volume<sup>1</sup> entitled *Appendicitis* by McKay is a guide for the general practitioner in the country, containing "all that he should be acquainted with before he attempts his first appendix operation."

In an informal and very "talky" type of discussion the reader will find a rather complete and accurately presented picture of this disease. Chapters cover anatomy, historical background, diagnosis, preparatory treatment, country operation, theater instruments, operation after treatment, acute appendicitis, purulent appendicitis, appendicitis with abscess, postoperative complications.

Most American surgeons will agree with the principles of treatment advocated—early operation, muscle splitting incision, keeping the fingers lateral to the cecum in the presence of suppuration and with the latter complication, leaving behind the appendix difficult of access. In question may be put such procedures as irrigation of abscess with ether or balsam of Peru, or packing with iodoform gauze.

The chief criticism of the book is its wordiness on the other hand, the author's literary style has simplicity and charm. J. R. BUCHHEIDER.

IN AN attractively bound and illustrated volume<sup>2</sup> of about 600 pages McBride clearly shows his great interest in the rehabilitation of injured persons. This interest is manifest in the manner in which he presents various ideas upon which can be based amicable settlements between interested parties after an injury to a workman. Since the gradual establishment by legislation of state controlled industrial commissions there has arisen for the doctor an exceptional opportunity to aid in a just distribution of the loss of time, the expense and disability between the injured person and his employer or insurance carrier. The doctor must always have an important rôle in such proceedings and the author's purpose is to impress upon him the necessity of having sufficient fundamental knowledge about disabilities to permit him to influence the decision along fair and impartial channels. Boiled down it is a question of prognosis, not given in a vague and general way but specifically. What can a man do with

<sup>1</sup> APPENDICITIS: WHEN AND HOW TO OPERATE, A GUIDE FOR THE GENERAL PRACTITIONER. By W. J. STEWART MCKAY, M.B. M.C. B.Sc. Sydney, Australia. Angus & Robertson Ltd. 1936.  
<sup>2</sup> DISABILITY EVALUATION: PRINCIPLES OF TREATMENT OF COMPENSABLE INJURIES. By Earl D. McBride, B.S. M.D. F.A.C.S. Philadelphia. J. B. L. PENNINO Co. 1936.

an analysis of the first metacarpophalangeal joint in various positions? Can he hold a pencil in a way permitting him to write? Can he make a fist, oppose his thumbs to all fingers? Can he grasp a heavy rope?

No real opinion can be given by the doctor unless he knows such things, and this volume is filled with opportunities to learn them. For instance, 101 pages are devoted to the subject of ankylosis alone. All joints and certainly all common positions are discussed in the light of the disability they cause. Many line drawings illustrate what a patient can and cannot do with a given joint affected. This is a particularly valuable chapter. Forty three pages are devoted to the examination of the disabled person, with a discussion of malingerism, exaggeration, traumatic neurosis, and hysteria. The industrial disability index, is given 48 pages of clear and reasonable discussion. Under this heading the author also reviews the causes of non-traumatic back disability.

Two subjects of importance were omitted, namely, spinal cord tumor, and gout. The use of the terms "plaster case" and "casing" instead of the common error, "plaster cast," is found throughout, and is to be commended. Chapters on the legal aspects of disability, the eye, and ear have been included, and are written by colleagues of the author.

It is apparent as one reads the book that the author would like to see methods for evaluation disability standardized. But he suggests in the preface that the difficulty lies very greatly in the difference of the attitudes of physicians, etc. "Without being too didactic he suggests by various tables methods of evaluation many doctors could use with benefit. Occasional misstatements are found which have undoubtedly been overlooked. For instance, on page 533, "the ulnar nerve supplies all the muscles of the forearm eminence," and on page 101 the terms protopathic and epicritic sensibilities have had their meanings reversed.

Certainly there are few surgeons today who have not been called upon at some time to care for patients injured in industry. Thus, for the majority this book fills a distinct need. It is an appeal to cast aside shibboleth in determining disability, and supporting this appeal one will find a large fund of facts and ideas co-ordinated to help the surgeon base his opinion upon sound reasoning.

JAMES K. STACE  
IN THE third edition of his *Atlas of Radiographs*, Bertles has revised and enlarged the previous volumes and has added a medicolegal section. The purpose has been to present an atlas "to show" what radiology can do, and is intended primarily for the clinician. Several pages have been devoted to a history of radiodiagnoses.

The volume of 560 pages containing 808 illustrations, both normal and abnormal, with brief descriptions and clinical notes is printed on glossy paper. A Descriptive Atlas of Radiographs, and also to Modern Clinical Methods. By A. Bertles. M.D. F.R.C.S. (Ed.) St. Louis the C. V. Mosby Co. 1936.

The *Descriptive Atlas of Radiographs* is an aid to Modern Clinical Methods. By A. Bertles. M.D. F.R.C.S. (Ed.) St. Louis the C. V. Mosby Co. 1936.

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Röntgenograms of bones are reproduced in silhouette by filling in the background by and the same with India ink. Many of the illustrations are accompanied by line tracings which are very helpful. The illustrations are sufficiently large to prevent loss of detail and are adequately large to prevent loss of detail. The presentation of reproductions of normal bones and epiphyses as well as other normal structures enhances the value of the volume. The atlas includes illustrations of the common rather than the rare lesions of the various systems.

This interesting volume fulfills the purpose for which it was intended by the author and should prove of interest to the radiologist and most useful to the physician engaged in general practice who seeks the help of the x ray in making an accurate diagnosis.

STOAN'S volume on the thyroid presents the views of a clinic which has been active in the treatment of thyroid disease for many years, and may be divided into three approximately equal parts, the first, presenting the author's ideas of thyroid function and pathology, the second, giving his surgical technique, the third, discussing hypothyroidism, parathyroid disease, and the historical aspects of the whole subject.

The first section is interesting. The physiology of the thyroid is analyzed and a theory of dystyroidism, which is later used in differentiating clinical forms of hypothyroidism, is constructed. The section on surgical technique is very thorough and the surgical anatomy of the thyroid and the adjacent structures is exhaustively presented. The historical section is valuable for its review of the development of goiter surgery from the era when, as the author says, treatment consisted of "such procedures as the injection of hot water, carbolic acid, potassium iodide, or tincture of iodine solutions into the gland," to the present era of surgical therapy.

PAUL STARR  
IN his *Plastic Surgery of the Nose* Sheehan presents a personal record of his extensive work. No other authors are mentioned so that there is no multiplicity of procedures for any one defect, one may feel that the author himself has considered the details already published and sifted them down to the present form, along with his own original ideas, of course.

The full page plates show excellent results obtained by the author in most of the defects mentioned in the text. The arrangement and sequence of these photographs seem somewhat mixed in places and the legends are too brief to be of much value. If the plates were in closer association with the text, the legends are too brief to be of much value.

The *Plastic Surgery of the Nose* Sheehan presents a personal record of his extensive work. No other authors are mentioned so that there is no multiplicity of procedures for any one defect, one may feel that the author himself has considered the details already published and sifted them down to the present form, along with his own original ideas, of course.

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the subject matter around them, they would also be more valuable, and at least to this reviewer, they would be more easily assimilated if they were all vertical in position instead of across the length of the page as most of them are.

The chapter on skin grafts is quite brief and includes sections on flaps, instruments and keloids.

The author diagrams his method of capillary drainage of keloids with silk threads and describes an instance in dealing with a keloid in a negro, after excision he radiated the wound with a tube of radon closed directly in the wound, presumably removing it and suturing the wound later. He concludes:

"It is enough to note the fact rather than to attempt to dogmatize on the effects to be deduced from what is known of the different orders of rays

Given the demonstration and making allowance for the state of the skin and the object to be obtained in the individual case, it is evident that there will be room for considerable variation, both in the potential of the emanation and in the time it is left in place. What is sought is the preparation of the skin to facilitate the normal process of circulation and so to prevent the occurrence or recurrence of those phenomena of inflammation that are attributable to the choking of the return circulations. Ray therapy is still in large measure, empirical both in theory and in practice. What is known of keloids is equally inconclusive. However gratifying the results of the experiments here described they are presented with reserves appropriate to the two fold uncertainty involved."

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

OXFORD MEDICAL PUBLICATIONS. ORIGINAL PAPERS OF RICHARD BRIGHT ON RENAL DISEASE. Edited by A. Arnold Osman DSC FRCP. London: Oxford University Press 1937.

SEGUNDAS JORNADAS RIOPLATENSES DE OBSTETRICIA Y GINECOLOGIA REALIZADAS EN BUENOS AIRES OCTUBRE DE 1936. Buenos Aires: Las Ciencias 1936.

OXFORD MEDICAL PUBLICATIONS. OPERATIVE SURGERY. By Alexander Miles M.D. LL.D. FRCS (Ed.) and D.P.D. Willie M.D. FRCS (Ed. and Eng.) 2d ed. London: Oxford University Press 1937.

HISTORY OF MODERN MORALS. By Max Hodann. London: William Heinemann (Medical Books) Ltd. 1937.

AUTOPSY DIAGNOSIS AND TECHNIQUE. By Otto Saphir M.D. New York and London: Paul B. Hoeber Inc. 1937.

MATERNITY AND POST-OPERATIVE EXERCISES. By Margaret Morris CSM M.G. and M. Randall S.K.N. SCM. F.M.M.G. New York: Oxford University Press 1936.

LEHRBUCH DER FRAUENHEILKUNDE. By Prof. Dr. W. Weibel. Vol. 1: GEBURTSHILFE. Berlin and Vienna: Urban & Schwarzenberg 1937.

ST. THOMAS'S HOSPITAL REPORTS. Editors: Prof. O.L.V.S. De Wesselow M.C. Max Page. Second series. Vol. 1. London: St. Thomas's Hospital 1936.

AN INTRODUCTION TO MEDICAL SCIENCE. By William Boyd M.D. MRCP (Edin.) FRCP. Dipl. Psych. FRS (Canada). Philadelphia: Lea & Febiger 1937.

THE HOME TREATMENT OF SPASTIC PARALYSIS. By Percy Merritt Girard M.D. FACS. Philadelphia: Montreal: London: J.B. Lippincott Co. 1937.

CLINICAL ROENTGENOLOGY OF THE CARDIOVASCULAR SYSTEM. ANATOMY, PHYSIOLOGY, PATHOLOGY, etc. By Hugo Roesler M.D. Springfield Ill. and Baltimore Md. Charles C. Thomas 1937.

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# SURGERY

## GYNECOLOGY AND OBSTETRICS

*An International Magazine, Published Monthly*

VOLUME 64

MAY, 1937

NUMBER 5

### OBSERVATIONS ON THE HUMAN BEING FOLLOWING

### COLECTOMY OR COLONIC EXCLUSION WITH ILEOSTOMY

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THE colon has certain definite functions. Absorption of fluid and some soluble substances takes place in the cecum, ascending colon, and proximal portion of the transverse colon, or those parts of the colon which are developed with the small bowel from the midgut. Storage takes place in the distal portion of the transverse colon, in the descending colon, and in the sigmoid flexure, which are developed from the hindgut. The colon also serves as a secretory and an excretory organ. These facts have previously been substantiated (6, 9, 12, 13, 20, 24). It can be said, therefore, that the colon plays an important rôle in bodily metabolism and is not the useless catch basin that it was conceived to be by Metchnikoff and Lane (12).

It is known, however, that man can live following the removal or exclusion of the colon. There has been much speculation about the effect of colectomy or colonic exclusion by ileostomy on bodily metabolism, and there also has been much discussion about the ability of the remainder of the intestinal tract to accommodate itself to the loss of the large intestine.

From the Division of Surgery, The Mayo Clinic, The Mayo Foundation, and the Department of Medicine, The Mayo Clinic, which done on the Internal Service, St. Mary's Hospital, Abolition of the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirement for the degree of Master of Science in Surgery.

419

general physical and mental reaction to the of the terminal portion of the ileum. The required for the passage of feces, the time of the ileum, changes in the feces, post-operative dilatation of the terminal portion changes in their mineral metabolism, post-hereditary polypoid.

These patients were studied in regard to polypoid, stricture or perirectal abscess, and ulcerative colitis, chronic ulcerative colitis with operative procedures were refractory chronic The 3 most frequent indications for these effort to offer the patient improved health more conservative treatment had failed, in an colonic exclusion by ileostomy was done after years following operation. Colectomy or were observed and studied as late as 5½ after operation for as long as 8 months, and Eight of the more recent cases were observed which the colon was excluded by ileostomy. The material studied consisted of 40 cases in which total colectomy was performed at the clinic and 5 cases in these animal investigations with observations made on human beings. The material studied and an attempt has been made to correlate have been previously studied with animals, human being. Certain phases of the problem study both the immediate and late effects of total colectomy or colonic exclusion on the

colectomy or colonic exclusion was also investigated. Each case is referred to in all instances by the same number.

#### MINERAL METABOLISM

Many investigators (15, 23, 24, 27) believed that the colon played a major role in the excretion of mineral salts. Schneider found that the excretion of calcium in the urine of dogs was markedly increased following colectomy. The small bowel did not excrete calcium. Johnson did not find that the human colon excreted calcium. Cattell drew attention to a marked loss of chlorides following ileostomy.

If the excessive loss of fluids which follows colectomy or colonic exclusion by ileostomy is sufficient to disturb seriously the physiologic equilibrium of any constituent within the body, it would seem reasonable that the concentration of that constituent in the blood would be altered. Quantitative determinations of the chemical constituents of the blood were therefore carried out in 8 cases (Table I).

Among these cases there were 2 instances of tetany. In both of these cases the tetany was relieved by administration of calcium. In 1 case the tetany occurred 6 months after operation but did not recur subsequently. In the other case tetany occurred repeatedly in association with bouts of diarrhea, examination of the ileum revealed chronic ulcerative disease.

No variations from normal were seen in the values for the urea in the blood or in the values for the phosphorous and total protein in the serum. In only 1 case was there a reduction of the value for the chloride in the plasma. However, following operation there was a moderate decrease in the values for calcium in the serum, this was consistent enough to be of significance. The values for calcium in the serum were all restored to normal in all cases at the end of the first month after operation, and remained within normal limits thereafter. This would suggest that colectomy or colonic exclusion with ileostomy does not give rise to serious disturbances of the chemical constituents of the blood which were studied.

#### DILATATION OF THE TERMINAL PORTION OF THE ILEUM FOLLOWING COLECTOMY OR COLONIC EXCLUSION WITH ILEOSTOMY

In dogs which were subjected to colectomy and ileorectostomy, a dilatation of the terminal portion of the ileum has been noted. Weiss and Porcher, Schneider, and Canavero (5), who made roentgenologic studies of dogs by using barium enemas, found a dilatation of the terminal portion of the ileum which they believed had progressed for several months to the point where the dilated ileum compared volumetrically with the removed colon, in other words, there was a volumetric compensation. No similar studies seem to have been recorded after an ileostomy.

As a preliminary study, in 36 cases in which the colon and terminal portion of the ileum were normal, roentgenograms were made after the administration of a barium enema, in order to determine the average diameter of the terminal portion of the ileum. The technique was constant and similar to that used in the cases in which ileostomy was performed. The mean and average diameter of the terminal portion of the ileum was found to be 2 centimeters.

Anatomic texts give the average diameter of the terminal portion of the ileum as 2 centimeters to 2.5 centimeters, but examination of segments of living bowel removed incident to performing an ileostomy or ileocolostomy revealed that the diameter was 1.6 centimeters. Roentgenologic examination of the terminal portion of the normal ileum revealed that the average diameter was 2 centimeters, as did the pre-operative roentgenograms in Cases 3, 6, and 7.

The terminal portion of the ileum was subjected to examination in 6 cases to determine the presence or absence of dilatation following ileostomy and the extent of the dilatation, if present. In 5 cases the patients were subjected to 1 or more roentgenologic examinations. Those cases in which operation was performed following ileostomy, or in which the patients came to necropsy likewise were studied. The roentgenographic studies were made after the administration of a barium enema. A catheter was introduced into the ileac stoma and barium under minimal pres-

WHITTAKER, BARGEN EFFECTS OF COLECTOMY OR COLONIC EXCLUSION 851  
TABLE I—QUANTITATIVE ANALYSIS OF BLOOD BEFORE AND AFTER ILEOSTOMY WITH OR WITHOUT COLECTOMY

Case	Operative procedure	Urea mgm per 100 c cm of blood			(Chlorides mgm per 100 c cm of plasma		
		Before operation			After operation		
1	Colectomy *	Interval	Value	Interval	Value	Interval	Value
		2 days	16	7 days	18	2 days	660
2	Ileostomy	2 days	20	2 days	553	7 days	604
		2 days	20	7 days	30	1 month	585
3	Colectomy	5 1/2 years	28	5 1/2 years	28	5 1/2 years	602
		5 1/2 years	28	5 1/2 years	28	5 1/2 years	612
4	Ileostomy	3 days	28	10 days	21	10 days	591
		3 days	28	1 month	16	1 month	590
5	Ileostomy	2 days	18	6 months	22	6 months	617
				6 months	36	6 months	594
6	Ileostomy			9 months	20	9 months	600
				9 months	20	9 months	584
7	Ileostomy			5 days	46	5 days	616
				12 days	42	12 days	616
8	Colectomy			5 days	22	10 days	594
				12 days	16	12 days	594
9	Ileostomy			7 months	20	7 months	594
				12 days	16	12 days	594
10	Colectomy			12 days	16	12 days	594
				12 days	16	12 days	594
11	Colectomy *	2 days	9 3	7 days	8 2	7 days	3 0
		2 days	9 3	7 days	7 8	7 days	3 0
2	Ileostomy	2 days	9 3	7 days	8 2	7 days	3 2
		2 days	9 3	7 days	9 6	1 month	3 0
3	Colectomy			5 1/2 years	10 2	1 month	3 0
				5 1/2 years	9 9	5 1/2 years	1 5
4	Ileostomy	3 days	8 9	10 days	9 2	3 days	1 5
				17 days	10 3	1 month	4 4
5	Ileostomy	2 days	9 2	6 months	9 2	6 months	4 2
				6 months	9 5	9 months	3 6
6	Ileostomy			9 months	9 5	9 months	4 2
				10 days	9 7	12 days	4 4
7	Ileostomy			10 days	10 0	1 month	4 0
				7 months	9 4	7 months	3 4
8	Colectomy			7 days	8 2	7 days	6 0
				1 month	10 2	1 month	6 0
Calcium mgm per 100 c cm of serum							
Phosphorus mgm per 100 c cm of serum							
1	Colectomy *	2 days	9 3	7 days	7 8	2 days	3 8
		2 days	9 3	7 days	7 8	2 days	3 8
2	Ileostomy	2 days	9 3	7 days	8 2	2 days	3 6
		2 days	9 3	7 days	9 6	2 days	3 6
3	Colectomy			5 1/2 years	10 2	1 month	4 4
				5 1/2 years	9 9	5 1/2 years	4 4
4	Ileostomy	3 days	8 9	10 days	9 2	3 days	4 4
				17 days	10 3	1 month	4 4
5	Ileostomy	2 days	9 2	6 months	9 2	6 months	4 2
				6 months	9 5	9 months	3 6
6	Ileostomy			9 months	9 5	9 months	4 2
				10 days	9 7	12 days	4 4
7	Ileostomy			10 days	10 0	1 month	4 0
				7 months	9 4	7 months	3 4
8	Colectomy			7 days	8 2	7 days	6 0
				1 month	10 2	1 month	6 0



Fig 1 Terminal portion of ileum in Case 3 a left before operation b after operation

sure was allowed to run in slowly and intermittently under fluoroscopic observation, until the loops of the ileum began to superimpose themselves on each other. Roentgenograms were then made after any excess barium had been expelled. The visualized loops were examined and their diameters determined. Table II gives the average diameters of the loops of the terminal portion of ileum in the 5 cases studied. Intestinal activity as studied by fluoroscopic examination seemed normal in all of these cases. In 3 of these cases preoperative roentgenologic examination which was made after the introduction of a barium

enema revealed that the diameter of the terminal portion of the ileum was normal (Figs 1 and 2).

Observations were also made at the time of operation, that is, with the abdomen opened. In Case 7, at the time of the ileostomy the terminal portion of the ileum measured 2 centimeters in diameter, and at the time of colectomy it was estimated to be dilated in a 3:2 ratio with the normal ileum. The 12 centimeters of ileum removed with the colon had a diameter of 1.6 centimeters.

In Case 4, at the time of ileostomy the diameter of the terminal portion of the ileum was 1.6 centimeters. Dilatation was definitely present at the time of colectomy. At necropsy, the terminal portion of the ileum measured 2.4 centimeters after it had been in form for a few days.

In Case 1, in which colectomy was performed 3 years following ileostomy, the terminal portion of the ileum was definitely dilated to approximately 3 centimeters in diameter.

In the cases in which an ileostomy was performed, roentgenologic examination revealed that the average diameter of the terminal portion of the ileum was 3 centimeters and operation or necropsy revealed a similar dilatation which could not be measured accurately. The dilatation does not seem to

TABLE II—DIAMETER OF TERMINAL PORTION OF ILEUM AS DETERMINED BY ROENTGENOLOGIC EXAMINATION FOLLOWING ADMINISTRATION OF A BARIUM ENEMA

Case	Pre-operative diameter cm	Postoperative diameter	
		Interval after operation	Diameter cm
3	1.9	5 years	1
4		1 month	.8
5		6 months	3.0
6	2	9 months	.8
7	9	month	3.2
7		4 months	3.2
Average	2.0		3.0



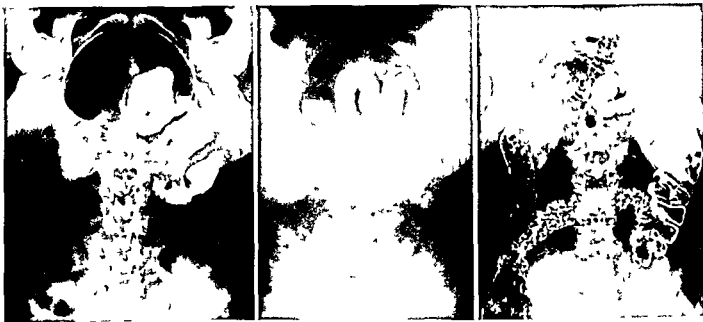


Fig 2 Terminal portion of ileum in Case 7, a before operation, b, 1 month after operation, c, 4½ months after operation

be progressive after the first month. In the absence of impeding strictures or sphincters it is thought that the dilatation is probably physiologic. There is no evidence, however, that the amount of dilatation present is sufficient to compensate volumetrically for the excluded colonic reservoir.

#### EXAMINATION OF THE STOOLS

Since colectomy was first performed it has been known that this procedure is followed by an early, progressive thickening of the stools Canavero (5), Deutsch, Weiss and Porcher, and many others have noted that colectomized animals and patients who have been subjected to an ileostomy have an intractable diarrhea in the immediate post-operative period. The water content of the stools of dogs that have been subjected to ileorectostomy has been demonstrated to be 90 to 95 per cent, this corresponds closely with the percentage of water in the contents of the normal ileum, which, according to Luciani, is 90. The reaction of the discharge from the terminal portion of the ileum has been carefully studied under various conditions Helie, as well as Hosoi, Alvarez, and Mann, found that the discharge was alkaline or neutral to litmus. Luciani, Dean, Bollman

The reaction of 23 specimens which were collected for 24 hours and the reaction of 23 stools at the time of expulsion usually had little odor. The reaction of 23 specimens was light to dark brown. The color of the ileostomy and colectomy. The color of other cases at intervals up to 5½ years after operation for as long as 8 months, and in these cases were observed from the day of under observation. The stools in some of the stools were studied in 6 of the cases. The stools were more rapidly than did protein or fat frequently passed through the small intestine. It was thought that carbohydrate was 1½ hours to 4½ hours to pass through the small intestine of dogs which had been subjected to colectomy. The average time that was required for these substances to pass through the small intestine of dogs which had been subjected to colectomy was 1½ hours to 4½ hours. It was thought that carbohydrate frequently passed through the small intestine more rapidly than did protein or fat.

specimens which were collected at the moment of expulsion were studied. Litmus was thought to be sufficiently accurate for the purpose. The reaction of the stool at the moment of expulsion was alkaline in each case. The reaction of the 24 hour specimens was acid.

There was a definite change in consistency of the stools in all cases. The consistency of the stools was graded 1 to 4, grade 1 was used to classify those stools which were practically formed and grade 4 was used to classify those which were practically fluid. The stools in Cases 4, 7, and 8 were observed from the day of operation. The first 24 hour specimen, which in each case was obtained on the third day, was entirely fluid and consisted of 800 cubic centimeters to 1,000 cubic centimeters of fluid containing approximately 50 cubic centimeters of sediment. At the end of 10 days there was an increase in sediment, and at the end of 2 weeks the stools had become uniform in consistency. Only at the end of a month was a definite thickening of the stool noted. They were graded 3, as they contained little fluid but no formed matter. This thickening was progressive for 3 months. There seemed to be little change after that. Stools which were grade 2, that is, stools which contained some formed matter were noted 6 months after operation in Case 5, 9 months after operation in Case 6, and 4½ months after operation in Case 7. In Case 7 no further change in the consistency of the stools was noted 7 months after the operation. Five and a half years after operation the consistency of the stools in Case 3 was grade 2 on 2 occasions and grade 1 on another occasion. One or more years after patients had been subjected to colectomy they usually reported that the stools were semiformed most of the time but also said that the stools occasionally were very loose. Little change in the stools was noted after the fourth month.

In Case 7 the percentage of water in the stools varied from 90.8 to 92, 4½ months after ileostomy, in Case 5 it varied from 91.2 to 93.2, 6 months after ileostomy, and in Case 3 it varied from 89.2 to 91.5, 5½ years after ileostomy. In the last case the per-

centage of water was determined in very hot weather, which might have accounted for the slight decrease.

The weight of the 24 hour specimens of feces was repeatedly determined in 5 cases. The average weight of the stools passed in 24 hours by a normal individual who is receiving an unrestricted general diet is 170 grams (17, 25). While the patients in these cases were eating an unrestricted general diet, the weight of the stools which were passed in 24 hours varied from 316 grams to 596 grams, the average weight being 433 grams. There was no progressive reduction in the weight of the stools after operation in any case. Some of the heaviest stools were found in Cases 3 and 5, 5½ years and 6 months, respectively, after ileostomy.

The fact that the discharge from an ileac stoma becomes progressively less liquid for some time after the ileostomy has been performed and the possibility that this phenomenon is related to changes in the time that the ingested material remains in the small intestine prompted us to study the rate of passage of ingested material through the small intestine and to compare this with the consistency of the discharge from the ileac stoma. In order to identify the stools for a given period, 5 grains (0.3 gram) of carmine was administered with the breakfast and the first appearance of the carmine was observed in the ileac discharge (Table III). The average time that is required for ingested material to reach the ileocecal region of normal subjects is from 2 to 4½ hours. The average time required for ingested material to reach the ileac stoma in the cases studied was 3 hours and 24 minutes. There did not seem to be any relation between the consistency of the stools and the time required for ingested material to reach the ileac stoma. In fact, it was discovered that in the cases in which the time required for the passage of ingested material through the small intestine was observed several months and 5½ years after operation the time was comparable to that observed immediately after the operation. In Case 3, the time required for the passage of material through the small intestine was slightly less than the average for

TABLE III—CONSISTENCY OF STOOLS AND TIME REQUIRED FOR INGESTED MATERIAL TO PASS THROUGH THE SMALL INTESTINE

Case	Operative procedure	Postoperative interval	Time required for ingested material to pass through small intestine hours and minutes	3	4	5	6	7	8	Average
3	Colectomy and ileostomy	5 5 years	2 25	1+	2	3 13	4 00	2		
			2 15	2	2	2 15	2 15	2		
		2 weeks	2 15	2	2	2 00	2 00	2		
		4 weeks	2 30	2+	2	2 00	2 00	2		
4	Ileostomy		2 15	2	2	2 00	2 00	2		
			4 00	2	2	2 00	2 00	2		
		2 weeks	3 13	1+	2	2 00	2 00	2		
		6 months	2 30	2+	2	2 00	2 00	2		
5	Ileostomy		2 25	1+	2	2 00	2 00	2		
			3 13	2	2	2 00	2 00	2		
		2 weeks	2 15	2	2	2 00	2 00	2		
		4 months	2 05	2+	2	2 00	2 00	2		
6	Ileostomy	9 months	4 25	2	2	2 00	2 00	2		
		3 weeks	4 00	3	2	2 00	2 00	2		
		3 weeks	4 00	3	2	2 00	2 00	2		
		4 months	3 45	2	2	2 00	2 00	2		
7	Ileostomy		4 00	3	2	2 00	2 00	2		
			4 15	2	2	2 00	2 00	2		
			4 45	1+	2	2 00	2 00	2		
		1 month	4 15	3	2	2 00	2 00	2		
8	Ileostomy		4 15	3	2	2 00	2 00	2		
			4 15	3	2	2 00	2 00	2		
			4 15	3	2	2 00	2 00	2		
			4 15	3	2	2 00	2 00	2		

the group of cases, although the stools were carefully calculated diets were given in 2 cases. All studies were made on the second day of administration of each diet. Alterations in the diet caused little variation in the stools or in the time required for ingested material to pass through the small intestine. The average water content of the ileac dejecta was 91.3 per cent, as compared with the average water content of the normal stool, which is 76 per cent.

This study did not indicate that the carbohydrate, protein, or fat in the diet should be limited in order to influence the activity of the ileac stoma.

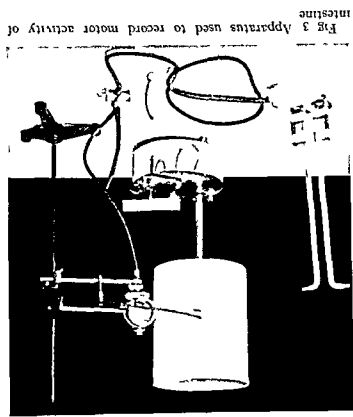


Fig. 3 Apparatus used to record motor activity of intestine

It is important to determine the part the motility of the small bowel plays, if any, in the progressive thickening of the stool and in the apparent reduction in the activity of the ileac stoma some time after colectomy has been performed.

Fundamental studies by Bayliss and Starling, Alvarez, Krishnan, Short, Hertz, and Castleton, have revealed certain facts concerning the motor activity of the terminal portion of the ileum. Two types of contractions have been noted, pendular (rhythmic) and peristaltic (tonic). The pendular movements were segmental and constant, they occurred at the rate of 8 to 14 per minute. Peristaltic waves arose at any point, ran any distance, and occurred at less frequent intervals. The bowel was always active, but was relatively quiet during a fasting period. The taking of food by mouth brought about increased activity, which was more marked following a fast than it was following a recent meal.

Weiss, who studied the terminal portion of the ileum of a dog which previously had been subjected to colectomy and ileorectostomy,

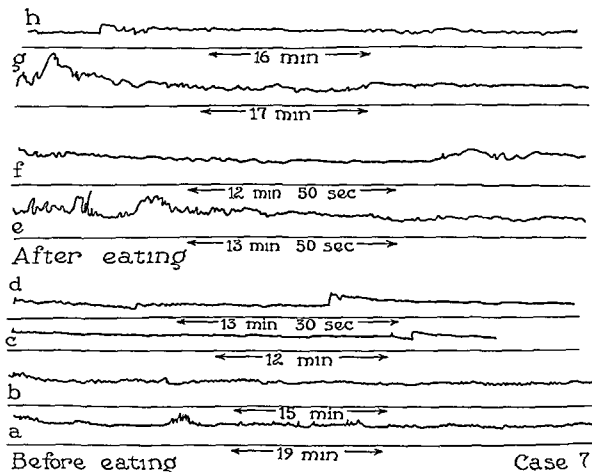


Fig 6 Intestinal tracings made 8 months after operation in Case 7

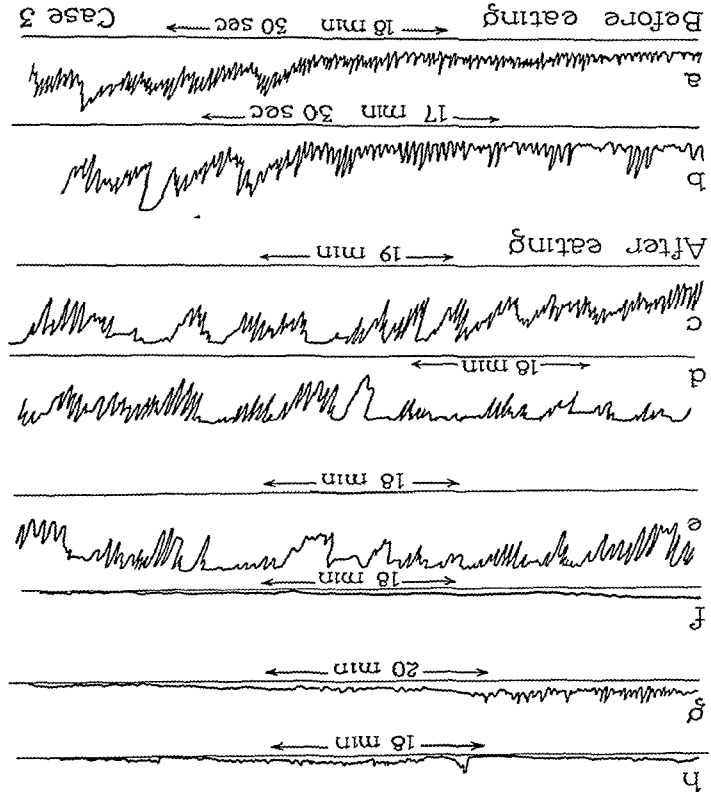
the intestine was observed for 8 months. No fundamental change was noted in the rhythmic contractions during this period. There was a decrease only in the amplitude of the tonic contraction waves. Eating brought about a variable increase in the tonic contraction waves (Figs 4, 5, and 6). In Case 3, the tracing was started after a fast of 16 hours and was continued for 3 hours. A full meal was served 40 minutes after the tracing was started and another full meal was served an hour and a half later. The intestine was rather active even after the fast. The first meal brought about a marked increase in the activity of the tonic contraction waves and in the general level of contractions, but after the second meal these changes were not so marked. These findings corresponded to the periods of intestinal activity which had been

observed by the patient. No fundamental change from the normal motor activity of the intestine was noted (Fig 7).

If the group of cases is studied as a whole certain facts regarding the motor activity of the terminal portion of the ileum become apparent following ileostomy. There was no slowing of the rate or decrease in the amplitude of the rhythmic contraction during the period following operation. No progressive reduction in the activity of the tonic waves was noted and there was no evidence of any reduction in the tone of the bowel. It may be said that during the time the stool is becoming thickened and the ileac stoma is said to be "quieting down," there is no evidence to support the theory that this adjustment is brought about by a progressive change in the motor activity of the bowel.

We did not note any change in the effect of traction waves after eating. The apparent change in the rhythmic contractions was ascribed to their partial or complete obliteration by the tonic contractions after the patient had eaten. However, the changes in the variable increase in activity of the tonic contraction by the tonic contraction throughout the period following operation (Table IV). There was a

Fig. 7 Intestinal tracings made 5 1/2 years after operation in Case 3



tonic contractions can be explained only by the fact that the ingestion of food stimulates the terminal portion of the ileum to stronger tonic (peristaltic) contractions, this stimulation does not change throughout the period of adjustment following operation. The increase in the strength of the tonic contractions occurred within 3 or 4 minutes after the beginning of ingestion of the meal, except in 1 case in which the response occurred 30 minutes later. The degree of increase varied considerably.

From these studies it may be said that there is no fundamental change in the motor activity of the ileum after ileostomy with or without colectomy. No fundamental change in the stimulating effect of the ingestion of food was noted during the postoperative interval. The intestinal tracings at all times were typically tracings of the small intestine and there was no suggestion that the motility of the terminal portion of the ileum becomes colonic in type, as has been suggested by experiments on dogs (28). The thickening of the discharge and the decrease in the number of discharges from the ileac stoma can in no way be ascribed to changes in the motor activity of the ileum.

#### PHYSICAL AND MENTAL REACTION TO COLECTOMY OR COLONIC EXCLUSION BY ILEOSTOMY

Close observation of 8 patients throughout prolonged postoperative periods and a careful inquiry into the condition of the patients in 37 other cases afforded an opportunity to compare the general physical and mental changes with the changes already noted.

The patients began to regain their strength approximately 1 month after operation. In the next 2 or 3 months the strength returned to normal. Little change was noted thereafter. There was a substantial gain in weight in each case after operation. In cases which were reviewed later than 1 year following operation, the patients reported that they were in better health than they were before the operation and they seemed to have average strength.

The number of discharges from the ileac stoma began to decrease 2 weeks after the operation and continued to do so for 3 or 4

months. At first, it was necessary to change the dressings 3 or 4 times each night but 3 months after the operation it rarely was necessary to change the dressing or bag at night. During the day, the bag was emptied 3 or 4 times. Activity was marked immediately after meals, and was prolonged after breakfast, when the activity often lasted an hour. Regularity of meals influenced the activity of the ileac stoma. The activity was decreased at night if the heaviest meal was taken at noon. Expulsion of gas created no problem or embarrassment after 3 months. As a rule, there was little trouble with foods beyond the individual variations seen among normal people. Ingestion of citrous fruits and fibrous vegetables in excess or drinking excessive amounts of water made the stool more liquid.

The most advantageous position for the ileac stoma was in the right lower quadrant of the abdomen. This permitted the bag to be worn in line with the thigh. If the ileum protruded about 3 centimeters the type of bag usually worn fitted about the bowel better than it did if the ileum was not allowed to protrude. Kaolin mixed with glycerin or petrolatum or ointment of zinc oxide was used on the surrounding skin, as necessary. However, the skin about the ileac stoma caused little trouble.

All patients studied were asked to express their mental reaction to an ileac stoma. Until the physical condition of the patients improved their mental attitude was less hopeful than it had been, but after 2 or 3 months the attitude was one of acceptance in preference to their previous condition. In the cases studied the patients came from all walks of life. They returned to their previous occupations and enjoyed sports, including swimming, as well as all social activities. They were better able to resume their economic and social activity than they were before operation. One woman said that she was able to play golf and dance. Four years after ileostomy and colectomy one man said "I have established lifelong habits. The use and care of an ileostomy becomes habitual and one gives it little thought." Another man said "So long as I can live in convenient sur-



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# ACUTE PERFORATION OF PEPTIC ULCER

## An Evaluation of Contributory and Exciting Causes

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HEREAS Finch (12) described the first case of peptic ulcer in 1670, the increasing relative importance of the disease did not begin to manifest itself until about 4 decades ago. At the present time probably not any feature of the disease is so little understood as the etiology. As an example of the recent state of our knowledge, McCann devotes no less than 30 pages to a review of theories concerning the etiology of peptic ulcer. The existence of this uncertainty, therefore, requires from time to time a reconsideration of the numerous factors which at least are contributory to the production of peptic ulcer and its complications. It is the purpose of this paper to contemplate the causes of ulcer along with other factors as they appear to conduce to its most serious complication, namely, acute perforation.

This study was made from the clinical records of 500 cases in which acute perforation complicated benign peptic ulcer. The features which are believed to be of etiological significance have been evaluated in terms of the percentage of cases in which each feature was present. A group of 500 cases derived from the same source and subjected to the same degree of critical analysis is believed to be sufficiently large to warrant certain conclusions.

An attempt will not be made here to review the voluminous literature on the etiology of acute perforation of peptic ulcer. A brief review of certain articles, however, will serve to indicate the trend of modern thought on this phase of the problem.

The incidence of acute perforation in peptic ulcer has been investigated by several authors. Eliason and Ebeling reported that in a series of 387 cases, Dunbar reported 6 per cent as having occurred in patients between 12 and 20 years of age. With reference to the frequency of perforation in adults, Poole and Dunbar, and Ebeling, Rhodes and Collins, occurred between the third and fifth decades.

Dunbar, and Hinton have reported cases in

Butka reported a case in an infant aged 4 days, and Finny reported one in a child aged 2 months. Jirsak and Persky, Robinson and O'Flynn have reported instances in children aged 7, 12, and 14 years, respectively. In a series of 387 cases, Dunbar reported 6 per cent as having occurred in patients between 12 and 20 years of age. With reference to the frequency of perforation in adults, Poole and Dunbar, and Ebeling, Rhodes and Collins, occurred between the third and fifth decades.

Dunbar, and Hinton have reported cases in

series of 729 cases of peptic ulcer from the combined records of services at the University of Pennsylvania and Philadelphia General Hospitals there was an incidence of perforation in slightly over 10 per cent. In 880 cases diagnosed as peptic ulcer, Brown reported slightly over 11 per cent of proved perforations. In a report on the incidence of perforation of peptic ulcer among soldiers in the United States Army, Trowl reported that whereas this complication occurred on the mainland in 7.7 per cent of cases, it was over four times as frequent among soldiers stationed in Hawaii.

An observation on the racial incidence of acute perforation was made by Brown, who in a report of 100 cases found that 10 per cent occurred in negroes.

Reports on the incidence of acute perforation of peptic ulcer according to sex vary greatly. For example, in 645 cases collected from the literature by Alloyman in 1901, 26.9 per cent of cases occurred in females. On the other hand, Eliason and Ebeling, in 1934, collected 2,630 cases from the literature wherein the frequency in females was as low as 3.2 per cent. In 934 cases reported by 10 authors between 1910 and 1934 the frequency of perforation in females was 7.17 per cent.

Reports in the literature indicate that acute perforation of peptic ulcer occurs at all ages.

## LITERATURE

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patients aged 71, 72, 74, and 80 years, respectively

Concerning social status and occupation, Rhodes and Collins reported that in their series acute perforation of peptic ulcer occurred in persons in the lower social scale who observe poor hygienic and dietary habits. In Robitschek's series, 32 per cent of patients were laborers, whereas in Shelly's group 10 per cent were chauffeurs.

Apparent seasonal variations in the symptoms of peptic ulcer have been reported repeatedly. It is commonly taught that symptoms are more marked in the spring and fall than in the summer and winter seasons. In Hinton's series of 103 cases, 44.7 per cent of perforations occurred in the months of March, April, October, and November. In Eliason and Ebeling's series, 32.4 per cent occurred in October, November, and December. Rhodes and Collins reported that in 70 per cent of their cases perforation occurred in the 6 month period constituting winter and spring. In Dunbar's series the largest number of perforations occurred in January and the next largest in March and July.

The question of the existence and duration of the symptoms of peptic ulcer prior to perforation is an interesting feature of this complication of the disease. In a report on the diagnostic symptoms and signs in this same group of 500 cases, I pointed out that symptoms characteristic of peptic ulcer preceded acute perforation in 76.1 per cent. Eliason and Ebeling reported that in 27 per cent of their cases symptoms had existed for less than 6 months whereas in 18.9 per cent of cases symptoms had persisted for 5 or more years. Moreover, in 48.2 per cent of their cases medical treatment had been employed prior to perforation.

Held and Goldbloom state that the frequent location of peptic ulcer on the anterior wall of the duodenum is the most significant fact in the frequency of perforation and is the reason that perforation of duodenal ulcer is more frequent than perforation of gastric ulcer. In the cases of Eliason and Ebeling over 80 per cent of perforations were on the anterior surface of the first portion of the duodenum. Of their gastric ulcers 50 per cent were situ-

ated on the anterior surface of the pylorus. In the cases of Jirasek and Persky, 30 per cent of perforations of gastric ulcer occurred through the anterior wall whereas 90 per cent of the duodenal ulcers were situated anteriorly.

Possible exciting causes mentioned in the literature on acute perforation of peptic ulcer are alcohol, physical exertion, food, foci of infection, trauma, and manipulation incidental to fluoroscopic examination with the barium meal. Troutt expressed his belief that excessive smoking and the consumption of impure alcoholic beverages contributed to the high incidence of perforation in American soldiers in Hawaii. Rhodes and Collins observed that perforation in many of their cases occurred after excessive indulgence in alcohol or food and that the majority bore evidence of poor oral hygiene. Despite the fact that perforation in many of their cases occurred while the patients were undergoing physical exertion, the cases were not held compensable under California law.

Colp concluded that sudden physical effort and distention of the affected viscus by food or otherwise are factors in causing sudden rupture of penetrating ulcers. In 6 of their cases, Eliason and Ebeling obtained evidence of the recent ingestion of food. Corlette analyzed the causes of perforation from the standpoint of pure physics. He pointed out that a general increase in pressure within the abdominal cavity, as by contraction of muscles of the abdominal wall, cannot cause perforation because the increase in pressure is the same within as without the hollow viscera. Contraction of the muscle in the walls of a diseased viscus, on the other hand, can produce an inequality of pressure within over that without the viscus, which, if it passes the bursting strain of the floor of the ulcer, will cause acute perforation. He stated, moreover, that external force exerted against the wall of the viscus adjacent to an ulcer can cause it to stretch and thereby rupture. Powers reported 3 cases wherein trauma was believed to be an etiological factor in acute perforation. Morrow reported 5 cases of perforation of the duodenum or stomach after trauma, in some of which chronic peptic ulcers apparently existed previously. His report is

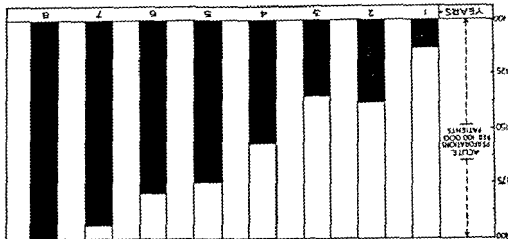


Fig. 1. Graphic presentation of the increase in incidence in hospital patients of acute perforation of peptic ulcer during the 8 year period beginning July 1, 1925, and ending June 30, 1933. In 190,000 hospital patients there were 167 acute perforations of peptic ulcer. In 1933 diagnoses of peptic ulcer there were 385 acute perforations. Average early incidence (8 year period) 19.6 per cent, increase in 8 year period 78.5 per cent.

of interest because under Minnesota law compensation was allowed in 4 of the 5 cases. Singer collected 34 cases from the literature and reported 4 additional cases wherein acute perforation followed soon after fluoroscopic examination of the stomach and duodenum. The manipulation of tissues incidental to examination was believed to be the exciting cause of acute perforation in these cases.

#### METHOD OF STUDY

The present study was conducted on the clinical records of the cases of gastric and duodenal ulcer complicated by perforation which were observed at the Los Angeles County General Hospital between September 9, 1921, and June 30, 1934. There were 500 cases observed during this period in which the clinical features were manifest in the acute form. In 491 cases the diagnosis of perforated peptic ulcer was confirmed by operation or autopsy. In 9 cases, comprising the small minority of 1.8 per cent, the history and physical findings were so typical as to exclude any reasonable doubt concerning the clinical diagnosis. Cases in which any doubt existed regarding the diagnosis were not included in this study. The important contributory and exciting etiological factors obtained from the clinical notes on each case were tabulated for study so that numerical and percentage values could be placed on them. The study was con-

*Incidence of acute perforation of peptic ulcer*  
In the period beginning on July 1, 1925, and ending on June 30, 1933 (the dates between which complete hospital records on incidence were available), there were 229,352 in-patients admitted to the Los Angeles County General Hospital (Table I). Among them there were 385 cases of acute perforation of peptic ulcer comprising an incidence of 167 per 100,000 of hospital patients. During the 8 year period

TABLE I.—YEARLY INCIDENCE OF ACUTE PERFORATION OF PEPTIC ULCER PER 100,000 HOSPITAL IN-PATIENTS DURING THE 8 YEAR PERIOD FROM JULY 1, 1925, TO JUNE 30, 1933, INCLUSIVE

Year	Number of patients	Number of perforations	Incidence of perforations per 100,000 patients
1925-1926	192,516	20	23
1926-1927	192,617	23,159	32
1927-1928	192,819	34	33
1928-1929	192,911	25,897	41
1929-1930	193,013	27,941	49
1930-1931	193,132	32,528	59
1931-1932	193,213	33,433	70
1932-1933	193,415	35	77
Total	1,932,107	229,352	385
Average	167		112

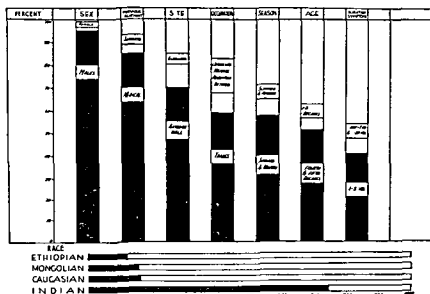


Fig 2 Graphic presentation expressed in percentage of cases wherein recorded, of the relative importance of contributory etiologic factors in acute perforation of peptic ulcer. The data on race are expressed in terms of number of cases per 100,000 patients.

under consideration, the yearly incidence rose from 112 to 200 per 100,000 patients or an increase during the period of 78.5 per cent (Fig 1). During the same period there were in the hospital 1,958 patients in whom the diagnosis of peptic ulcer was made, including the 385 cases of perforated peptic ulcer (Table II). The yearly proportion of acute perforations among these patients ranged from 13.8 to 30.5 with an average of 19.6 per cent. Whereas the incidence of acute perforation of peptic ulcer was 1.67 per thousand hospital patients the proportion of perforations in peptic ulcer patients was nearly 1 in 5.

TABLE II—YEARLY PERCENTAGE OF ACUTE PERFORATION IN HOSPITAL DIAGNOSES OF PEPTIC ULCER DURING THE 8 YEAR PERIOD FROM JULY 1, 1925, TO JUNE 30, 1933, INCLUSIVE

Year	Number of diagnoses of peptic ulcer	Number of acute perforations of peptic ulcer	Percentage of perforations in peptic ulcer diagnoses
1925-1926	132	23	17.4
1926-1927	173	32	18.4
1927-1928	252	34	13.8
1928-1929	66	41	15.4
1929-1930	234	49	20.9
1930-1931	287	59	20.5
1931-1932	229	70	30.5
1932-1933	385	77	20.0
Total	1958	385	Aver 19.6

**Contributory etiologic factors.** A comparison of the relative importance of the several contributory etiologic factors is shown in Figure 2.

**Race.** Covering the period between July 1, 1928, and June 30, 1934, hospital records relative to the number of in patients according to race and sex were available (Table III). Among 211,309 Caucasian patients there were 332 cases of acute perforation of peptic ulcer, comprising an incidence of 157 per 100,000. The incidence among Indians was 746, among Mongolians 156, and among Ethiopians (negroes) 121.

**Sex.** During this period there were 106,389 male and 102,431 female in patients in the hospital (Table IV). There were 341 acute perforated peptic ulcers in males and 16 in females. The sex incidence per 100,000 hospital patients, therefore, was 320 among males and 15 among females. In the entire series of 500 cases of acute perforation of peptic ulcer the incidence in males and females was 94.2 and 5.8 per cent, respectively.

**Age.** In this series of 500 cases there were no acute perforations in the first decade of life (Table V). There were 10, comprising 2 per cent of cases, in the second decade. In the fourth and fifth decades combined, there were 262 cases representing 52.2 per cent. In the

TABLE V—AGE DISTRIBUTION OF 500 CASES OF

ACUTE PERFORATION OF PEPTIC ULCER

Age years	Number of patients	Percentage of patients
1-10	0	0
11-20	0	0
21-30	10	2
31-40	85	17
41-50	131	26
51-60	130	26
61-70	79	16
71-80	40	8
81-90	22	4
91-100	3	0
Total	500	100

TABLE VI—INCIDENCE OF ACUTE PERFORATION

OF PEPTIC ULCER IN 453 CASES ACCORDING TO OCCUPATION

Classes of occupations	Number of patients	Percentage of patients
Unskilled	70	15
Trades (skilled)	266	58
Household	20	4
Mental work	64	14
Professional-Executive	26	6
Retired	7	1
Not recorded	453	100

TABLE VIIA—MONTHLY INCIDENCE IN 500

CASES OF ACUTE PERFORATION OF PEPTIC ULCER

Month	Number of patients	Percentage of patients
January	51	10
February	44	9
March	58	12
April	46	9
May	47	9
June	34	7
July	47	9
August	33	7
September	40	8
October	47	9
November	41	8
December	500	100

TABLE VIIB—SEASONAL INCIDENCE IN 500

CASES OF ACUTE PERFORATION OF PEPTIC ULCER

Season	Number of patients	Percentage of patients
Spring	152	30
Summer	93	18
Autumn	116	23
Winter	139	27
Total	500	100

a monthly incidence of from 40 to 58 cases, the incidence from June through September was lowest in summer, being 18 per cent, highest in spring at 30 per cent, with 23 per cent and 27 per cent in autumn and winter, respectively.

TABLE III—INCIDENCE PER 100,000 PATIENTS

OF ACUTE PERFORATION OF PEPTIC ULCER

PERIOD FROM JULY 1, 1928, TO JUNE 30, 1934, INCLUSIVE

Race	Number of patients	Number of patients per 100,000	Incidence
Indian	134	1	746
Caucasian	211,309	332	157
Mongolian	1,280	2	150
Lithuanian (negro)	14,046	17	121
Total			

TABLE IVA—INCIDENCE PER 100,000 PATIENTS

OF ACUTE PERFORATION OF PEPTIC ULCER ACCORDING TO SEX DURING THE 6 YEAR PERIOD FROM JULY 1, 1928, TO JUNE 30, 1934, INCLUSIVE

Sex	Number of patients	Number of patients per 100,000	Incidence
Male	106,389	341	320
Female	102,431	16	15
Total			

TABLE IVB—PERCENTAGE OF SEX INCIDENCE

IN THE GROUP OF 500 CASES

Sex	Percentage of acute perforations according to sex	Percentage of acute perforations according to sex
Male	471	94
Female	29	5
Total	500	100

decades next younger and next older, namely, the third and sixth combined, there were 164 cases or 32 per cent. In other words, 85 per cent of cases occurred in the third to sixth decades, inclusive. In the seventh, eighth, and ninth decades 80, 44, and 0 per cent of cases, respectively, were represented.

**Occupation.** The occupations of the patients were recorded in 453 cases (Table VII). Retired persons comprised 15 per cent and household workers, including housewives, 44 per cent. Unskilled workers composed 15 per cent of cases. This group was slightly outnumbered by mental workers, business executives, and professional people combined, who constituted 19 per cent of cases. The largest group was composed of skilled tradesmen who comprised 58 per cent of cases.

**Month and season.** There was an appreciable variation in the monthly occurrence of acute perforation of peptic ulcer (Table VII). Whereas from October through May there was

TABLE VIII — DISTRIBUTION OF 303 ACUTE PERFORATIONS OF PEPTIC ULCER ACCORDING TO DURATION OF SYMPTOMS

Duration	Number of perforations	Percentage of perforations
1-30 days	23	7.6
1-12 months	44	14.5
1-5 years	124	41.0
5-10 years	66	
10-15 years	20	32.7
15-20 years	13	
20 or more years	13	4.2
Not recorded	303	
Total	197 (39.4%)	
	500	100.0

TABLE IX — INCIDENCE OF ACUTE PERFORATION OF PEPTIC ULCER IN 89 PREVIOUSLY TREATED CASES

Treatment	Number of perforations	Percentage of perforations
Medical	76	85.4
Surgical	13	14.6
Total	89	
Not recorded	411	
Total	500	100.0

*Duration of symptoms* The duration of symptoms of peptic ulcer prior to perforation was recorded in 303 cases (Table VIII). Of these cases, 7.6 per cent of patients had noted symptoms for 1 month or less. In 14.5 per cent of cases, symptoms had been present for from 1 to 12 months, in 41.0 per cent, from 1 to 5 years, in 32.7 per cent, from 5 to 20 years and in 4.2 per cent, for over 20 years.

*Previous treatment* In 89 cases treatment for peptic ulcer had been instituted prior to perforation (Table IX). Of these 85.4 per cent had had medical treatment whereas 14.6 per cent had been treated surgically.

*Site of perforation* The site of the perforation was recorded in 483 cases (Table X). In 69.0 per cent, the perforation was situated on the anterior wall of the stomach or duodenum. In 27.6 per cent of the cases, it was situated elsewhere.

*Exciting causes* Several factors which have been mentioned as exciting causes of acute perforation of peptic ulcer were recorded in 147 cases (Table XI, Fig. 3). In 7.5 per cent of these cases the patients had drunk some form of alcoholic beverage and an additional 24.5 per cent had taken food within 1 hour prior to the onset of the symptoms of perforation. In 59.0 per cent of cases the patients were undergoing physical exertion at the time

TABLE X — INCIDENCE OF ACUTE PERFORATION IN 500 CASES OF PEPTIC ULCER

Site	Number of perforations	Percentage of perforations
Anterior wall	345	69.0
Elsewhere	138	27.6
Not recorded	17	3.4
Total	500	100.0

perforation occurred. On the other hand, 39 patients were either asleep or at rest when perforation took place. If, like exertion, rest could be conceived of as an exciting cause of perforation the comparative percentages of cases would be 46.7 and 20.9 per cent, respectively. In 2.8 per cent of cases each, external trauma and recent x-ray examination with the opaque meal seemed to be factors which excited acute perforation. The combination of alcohol and exertion was present in 2 cases or 1.3 per cent whereas food in combination with either exertion, sleep, or alcohol each were present in 1 or 0.7 per cent of cases.

#### ANALYSIS AND EVALUATION OF DATA

##### *Incidence of acute perforation*

An analysis of the data which are herein presented disclosed some interesting and significant facts on the incidence and increasing importance of acute perforation of peptic ulcer (Fig. 1). During the 8 year period ending on June 30, 1933, considerable variation in the yearly number of diagnoses of peptic ulcer is manifest. The proportion of acute perforations also varies from year to year but an average for the period of approximately 20 per cent is maintained. The increasing importance of acute perforation generally as well as in the hospital is indicated by the fact that per 100,000 patients, the incidence has risen from 112 to 200. This represents an increase in 8 years of 78.5 per cent. As the most common cause of death in peptic ulcer these figures show a striking similarity to the mortality statistics from 1900 to 1933, as reported by Rice for the Department of Health of New York City.

##### *Contributory etiological factors*

*Race* The data on the racial incidence of acute perforation reveal several points of interest. The number of Caucasian and Ethiopian patients is sufficient to give an accurate indica-

TABLE VI.—FREQUENCY OF POSSIBLE EXCITING FACTORS IN 147 CASES OF ACUTE PERFORATION OF PEPTIC ULCER

Exciting factors	Number of cases	Percentage (20.9%)
Food	11	7.5
Alcohol	36	24.5
Exertion	87	59.0
Trauma	4	2.8
Ray examination	4	2.8
Alcohol and exertion	2	1.3
Food and exertion	1	0.7
Food and sleep	1	0.7
Sleep	30	20.7
Not recorded	314	212.0
Total	500	100.0

Fig. 3. Graphic presentation expressed in terms of percentage of cases wherein recorded, of the relative importance of the so called exciting etiologic factors in acute perforation of peptic ulcer



are available only relative estimates of the incidence of acute perforation of peptic ulcer in the various occupations can be made. In 3 of the 6 classes other contributing factors enter into consideration. For example, the factor of age must be taken into consideration as a partial explanation of the low incidence in the retired group. Similarly, with respect to the professional-executive group, economic and social factors are of importance and in the household workers group, sex is an important factor. Of the 3 remaining groups it appears to be of significance that the incidence of perforation is about the same in the unskilled as in the mental workers, whereas nearly 60 per cent of the entire series of cases belongs to the trades or skilled workers' group. The latter facts appear to ignore social and economic factors somewhat. Moreover, they are not quite in keeping with the observations of Rhodes and Collins (whose cases were collected from a comparable source, namely, the emergency surgery service of the city of San Francisco). The majority of these patients belonged to the lower social strata.)

*Month and season.* It will be recalled that there were slight variations in the frequency of acute perforation from month to month throughout the year. Starting from a low point in July, the incidence gradually rose with slight recessions through November and January, reaching the highest point in March and falling off sharply thereafter. While there were a great number of cases in spring and autumn over the number in summer, a recession in winter, as is commonly taught, was not observed.

One of the most striking features of peptic ulcer is the marked difference in sex incidence. The findings of this study confirm those of previous studies relative to the marked preponderance of males among the afflicted. The occurrence of acute perforation in males in over 94 per cent of cases strongly indicates some constitutional factor at play which as yet remains unidentified.

While the age occurrence of acute perforation of peptic ulcer represented in this study covers the broad span of 90 years, exclusive only of the first decade, the case frequency in the different decades exhibits distinct zones of demarcation. The data indicate is distinctly a disease of adult middle life. For example, there were nearly 6 times as many cases in the four decades from the third through the sixth as in the 5 remaining decades. There were over 8 times more cases in the third decade than in the second and about twice more in the fourth than in the third. After the fifth decade the number of cases in each succeeding decade fell off by about 50 per cent per decade.

Until data relative to occupation hospital admissions according to occupation

*Duration of symptoms* The duration of symptoms was not recorded in 197, or 39.4 per cent of cases. In my communication on the diagnostic symptoms and signs in this series of cases, I pointed out that 81 cases were not interrogated regarding a previous history of ulcer. Deducting the latter from the former group there are left 116 cases, or 23.2 per cent, of the 500 cases in which presumably the symptoms were so brief or so mild as to be unworthy of recollection or of record. Among the remaining 303 cases, the 41 per cent of patients, in whom symptoms had existed for from 1 to 5 years, might reasonably be expected to have gained sufficient knowledge of peptic ulcer as to cause them to observe certain precautions against perforation. Of the remaining 59 per cent of patients, those in whom the symptoms had existed from 1 day to 12 months, the duration probably was so brief or transitory that many of the patients could reasonably be excused for their lack of appreciation of the significance of their disease. The patients in whom the chronicity had persisted for a period of time covering from 5 to 20 or more years may have grown careless of their observance of health programs.

*Previous treatment* While acute perforation took place in 89 previously diagnosed and treated patients, it is not within the scope of this paper to formulate of any conclusions concerning the adequacy of either medical or surgical treatment. The chief point to be learned, however, is that the number of perforations in previously treated patients is sufficiently large to emphasize the fact that in any patient with peptic ulcer, either treated or untreated, the possibility of acute perforation is a constant threat to the life and health of its bearer.

*Site of ulcer* That the situation of peptic ulcer on the anterior wall of the stomach or duodenum is an important factor predisposing to acute perforation is amply attested to by the fact that this condition obtained in 69 per cent of the cases which comprise this study. It, however, does not bear out the statement made by Held and Goldbloom, that it is the single most important factor in acute perforation.

### Exciting causes

So long as the lack of knowledge of a specific cause of peptic ulcer exists, the conception of exciting causes of acute perforation will remain debatable. However, the mere coincidence of certain factors with acute perforation in so large a number as 147 cases demands a certain degree of recognition. Of the several factors mentioned, and ignoring the statistics for the moment, it appears, in view of the mechanics involved, that substances within, which are capable of distending the stomach or duodenum, such as food or drink, and forcible manipulation of the viscera, as in fluoroscopic examination, or possibly local trauma, are the most important exciting causes of acute perforation.

### SUMMARY AND CONCLUSIONS

This study reveals certain facts concerning the relative importance of many factors which are believed to be exciting or contributory to acute perforation of peptic ulcer. Additional significance is given to the study by virtue of the large number of cases studied and because it represents the recent experience of the largest general hospital in the United States.<sup>1</sup>

The salient facts revealed are as follows:

1 During an 8 year period ending on June 30, 1933, the yearly incidence of acute perforation of peptic ulcer per 100,000 hospital in patients has risen by 78.5 per cent.

2 The frequency of acute perforation among all cases diagnosed as peptic ulcer during the 8 year period was about 1 in 5.

3 The incidence of acute perforation per 100,000 Caucasian hospital in patients was 157, whereas in Ethiopians (negroes) it was 23 per cent lower.

4 Acute perforation of peptic ulcer occurred in males in 94 per cent of cases.

5 Acute perforation of peptic ulcer occurred in every decade from the second through the ninth with 52.2 per cent of cases in the fourth and fifth decades combined.

6 Sixty per cent of the cases of acute perforation occurred in skilled trades people.

<sup>1</sup>The fifteenth annual 1935 presentation of hospital data by the Council of Medical Education and Hospitals of the American Medical Association specifies beds, rated capacity as follows: Los Angeles General Hospital, Los Angeles, 5,266; Cook County Hospital, Chicago, 3,150; King's County Hospital, Brooklyn, 3,042; Philadelphia General Hospital, Philadelphia, 2,500; Bellevue Hospital, New York City, 2,143.



- 7 The highest number of perforations occurred in March and the lowest in July. Correspondingly, the greatest number occurred in the spring and the least in the summer
  - 8 The duration of symptoms ranged from less than 1 month to 20 years or over, with the greatest number of cases in the 1 to 5 year group
  - 9 Acute perforation occurred in 89 cases which previously had been diagnosed and treated by medical or surgical methods
  - 10 In 69 per cent of cases the perforation occurred on the anterior wall of the stomach or duodenum
  - 11 Of the so called exciting causes of peptic ulcer the greatest number occurred while the patient was undergoing physical exertion
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## LYMPHATICS IN OMENIAL ADHESIONS

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THE fact that the omentum forms adhesions rapidly with other abdominal viscera upon irritation is generally recognized. The importance of such adhesions in the repair of intestinal injuries has been emphasized by Clark, Neuhoef and Wiener, Richardson, Hertzler, Corbett, Fenton and Peet, Rothchild, Bothe, Figurelli and others. The studies of Hertzler on the genesis of peritoneal adhesions are most extensive. Other investigators have been concerned chiefly with the question of the participation of blood vessels in the formation of adhesions. Senn believed that anastomoses were formed between hemal channels of the gut and omentum within 15 to 48 hours after chemical irritation of the intestine and Gundermann observed that these vessels were persistent after a period of 3 months. In employing the injection method, Girolaï demonstrated conclusively the continuity of blood vessels from the intestine to the omentum. Springer, Asoh, and Stropeni evidently unaware of Girolaï's experiments used similar methods to reach the same conclusions. Histological studies of adhesions involving the intestine and omentum have yielded divergent interpretations. Bloomhardt, Andrews and Hetherington were unable to demonstrate blood vascular anastomoses but Kovacs observed them 24 hours after operation. The figures of histological preparations presented by Asoh confirm their existence.

The behavior of the lymph vessels in omental adhesions has not received sufficient study. Indeed, the presence of omental lymphatics has been questioned frequently, but the recent works of Simer, Fischer and Dick leave no doubt of the existence of these channels. The last named investigator became interested in this problem after observing that 2 patients were relieved of symptoms of elephantiasis by the establishment of post-operative adhesions between the subcutaneous

tissue of the anterior body wall and the distal portion of the omental sac. He attempted, unsuccessfully, to demonstrate anastomoses of lymph vessels in experimental adhesions in the rabbit, but expressed the opinion that such connections actually exist. Braithwaite, Macguire, and other surgeons apparently concur in this belief. They have suggested a lymphatic connection by way of the adherent omentum in explanation of the common occurrence of gastric and duodenal ulcers and cholecystitis following inflammation of the appendix.

Our investigation deals with the study of newly formed lymph channels in experimental adhesions of the omentum and jejunum. Laparotomies were performed on dogs which were anesthetized with nembutal. In all animals, the mesenteric blood and lymph vessels of a small portion of jejunum were ligated 4 centimeters from the intestine. The serosa was irritated mechanically, and the distal portion of the omental sac was sutured to it. An additional suture was made involving the omentum and the mesentery in four instances. Post-mortem examinations followed the operations at intervals of 6 to 17 days, and in 10 animals adhesions were studied. Sub-renal and intramuscular injections of India ink were made in the jejunum near the omental adhesions and after gross examination, tissue was selected for microscopic study.

This material was fixed in 10 per cent formalin, embedded in paraffin, and sectioned serially 50 microns in thickness. Spreads of the omentum were made from regions in which the lymph vessels were delineated clearly as a result of the ink injections.

In successful attempts to demonstrate the continuity of the jejunal and omental lymphatics through the adhesions, ink was seen to pass from the ink bleb of the intestinal wall into the omental vessels and, eventually, to reach the duodenal or splenic nodes. From a study of omental spreads it was found that near adhesions, the peritoneal plexuses of

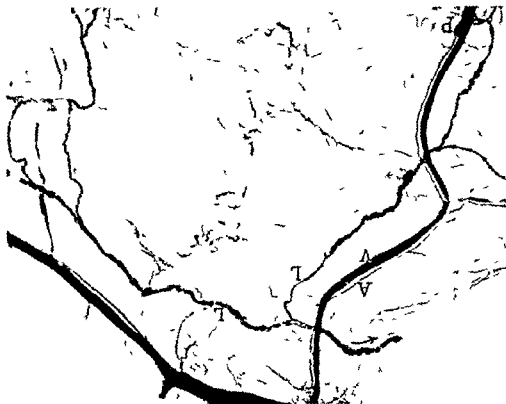


Fig. 1. An omental spread showing lymph vessels of the peritoneal type *P* and the lateral type *L*. The lymphatics contain ink which was injected into the intestinal wall near an adhesion of the jejunum and omentum. *A*, Artery; *V*, vein. The distal end of the omentum is at the bottom of the figure and the arrow indicates the direction of lymph flow to the duodenal node.

omental lymphatics (Fig. 1, *P*) were filled with the injection mass. This was soon shunted to the lateral lymphatic channels (Fig. 1, *L*) which could be seen extending to the collecting nodes. Examination of serial sections made from tissue involved in the adhesion verified the lymphatic nature of these vessels.

In the course of study of an adhesion it illustrates the continuity of the pathway of the injection mass between the two structures.

Returning to a study of the reconstruction, it is evident in this case that the peritoneal lymphatics could not be traced from the jejunum into the omentum, nor was it possible to see a blood-vascular junction. This may have its explanation in the penetration of

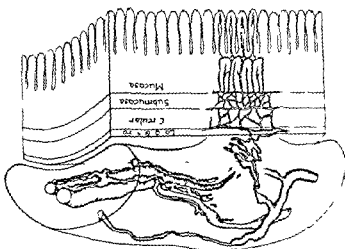


Fig. 2. Diagram showing the relation of a portion of the jejunum and omentum involved in an adhesion. The structures indicated by shading were reconstructed graphically. Lymphatics are indicated by stippling, and blood vessels by critical lines. Subserosal vessels of the jejunum with a lateral lymphatic vessel. Peritoneal lymphatics of the omentum could not be traced to their connection with the serosal lymphatics of the intestine. The layers of the intestinal wall and the schematic arrangement of the jejunal lymphatics are indicated.



Fig 3 A photomicrograph of a section of the adhesion shown in Figure 2. The omentum *O* is adherent to the jejunum at *X* and the ink filled lymph vessel *L* is a part of the anastomosis between intestinal and omental lymphatics. The position of a ligature used in establishing the adhesion is shown by the cavity *C* partially filled with ink. A connective tissue strand *S* forms a part of the adhesion and contains anastomosing lymph vessels.

was difficult to discern the walls of the vessels. There can be no doubt, however, that anastomosis of blood vessels does occur. In some instances, the injected ink entered the veins of the jejunum instead of the lymph channels. When this occurred the omental veins were colored quickly by the injection fluid. This finding confirms the observations of Girola<sup>11</sup>.

The majority of investigators have been concerned chiefly with the intimate adhesions

of the peritoneal surfaces, similar to the inflammatory area shown in Figure 3. Little attention has been paid to strands of tissue connecting the two surfaces. When small blocks of tissue are examined by means of the compound dissecting microscope, such strands are seen to be numerous near the region of most intimate contact and become fewer as the periphery is approached. The photomicrographs published by Lenton and Peet and by Figurelli show good examples of these connecting strands. They evidently, considered them of little significance.

Following the injection of the jejunal lymphatics with India ink, many of the single strands of tissue connecting the jejunum and the omentum became colored. A study of serial sections through such a region revealed the fact that connecting lymphatic and blood vessels existed in them. Figure 4 illustrates this fact. The strand containing ink filled lymphatics is designated, *S*, and the line of juncture of the omentum and jejunum, *X*. A similar strand magnified more highly, is shown in Figure 5. In this case the lym



Fig 4 Photomicrograph of a section of an adhesion involving the omentum and jejunum. Note the ink filled anastomosis of a subserosal intestinal lymphatic with those of the omentum by means of connective tissue strand *S*. The line of adhesion is indicated by *X*. *L* lymph channel of the omentum. *B* = blood vessel in omentum. *II* lymph vessels in the subserosal and muscular layers of the jejunum.

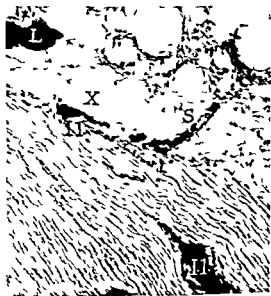


Fig 5 A photomicrograph at higher magnification of a section through an adhesion of the jejunum and omentum. The line of adhesion is indicated by *X*. A connective tissue strand *S* contains an ink filled lymph vessel which connects the lymphatics of the intestine and omentum. *L*, Omental lymph channel. *II* lymph vessels of the subserosal and muscle layers of the jejunum.

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This study shows that lymphatic connections are established between the jejunum and omentum after experimental adhesions have been induced. Injections with India ink show 8 days after operation

Postmortem examinations were made on dogs at varying intervals after the operation to determine the minimum time necessary for the establishment of lymphatic anastomoses. Such connections could not be demonstrated readily in those of 8 days or more. The union of the lymph channels of adherent organs is a progressive growth, for in the well developed adhesion of 17 days, ink passed from the intestinal lymph vessels to those of the omentum with greater rapidity than in newer adhesions

# THE SYNDROME OF CONGENITAL ABSENCE OF THE FIBULA

## Report of 3 Cases with Special Reference to Pathogenesis and Treatment

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**T**EXT books on orthopedic surgery do not contain an adequate conception of the mechanism of formation of a common deformity of the lower limb, usually referred to under the title of congenital absence of the fibula (1, 48). The present state of knowledge of embryology has advanced beyond surgical comprehension of this deformity. Recently, the authors have encountered 3 cases of this syndrome in different stages of development. A study of these cases in comparison with the methods of treatment recommended in the literature shows that many of these methods are physiologically unsound. It is probable that no one type of treatment can be applied to all cases as the indications for interference vary with the stage of neglect of the condition, the age of the patient, and associated deformities.

That the condition is not rare is indicated by the recent report of Lapasset and Cahuzac who found 29 cases in the literature prior to their report of 1 bilateral case. These authors state that such a deformity occurs once in 3,000 instances of all surgical conditions admitted to the hospital. In this report we will not attempt to review all the cases in the literature as this has already been adequately done (9, 11, 15, 23, 31, 32, 42). We wish to describe the deformity in detail with special reference to anatomic facts revealed by dissection and roentgenology. In all of our 3 cases, as well as in the cases in the literature, certain developmental trends are seen. These will be pointed out later.

### EMBRYOLOGY

The origins of such a defect must occur during or previous to differentiation of the scleroblastema of the limb bud in the embryo. A clear account of the early formation of the

anlage for the limbs is given by Bardeen and Lewis, which may be summarized as follows:

During the second half of the third week of fetal life there occurs an especially marked thickening opposite the twenty-first to the twenty-sixth spinal myotomes. This shortly differentiates into the limb bud. From the basal portion of each limb bud are developed the limb girdle and thigh. From the distal part are developed forelimb and foot. The scleroblastema, or skeletal anlage, is already present in the sixth week of fetal life. In this, the cartilaginous skeleton is differentiated and this in turn is replaced by the osseous skeleton. It is not clear whether the anlagen of the tibia and fibula begin as separate sheets which become divided. In an 11 millimeter embryo the blastemal anlagen are differentiated but not quite completely divided. In an embryo of 16 to 18 millimeters the tibia and fibula are quite separate. By the seventh week the skeletal structure in the posterior limb has undergone extensive differentiation. The rudiments of all the bones of the leg may be seen in the form of cartilage except the terminal phalanges of the three outer toes which have not yet appeared. The musculature of the posterior limb is so far differentiated that all muscles can be distinguished except the lumbricales. From this brief account of the early development of the skeleton in the limb bud it can be seen that the defect could be recognized anatomically as early as the fifth week of fetal life. This implies a very early and fundamental origin of the defect.

### REPORT OF CASES

**CASE 1.** Male aged 4 years, was seen at the University of Chicago Clinics in April 1931, with deformities of both feet. These had been present since birth but had not yielded to cast applications which had been prescribed elsewhere. The physical examination was normal except for the appearance of both lower limbs below the knees (Fig. 1). Both legs were abnormally short and bowed anteriorly. A

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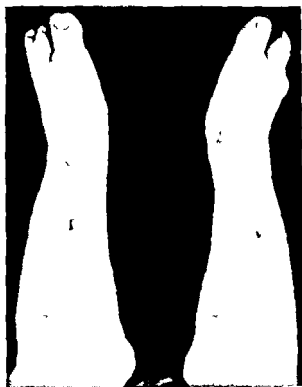


Fig 1 Case 1 Appearance of patient's lower extremities upon admission to the hospital at the age of 4 years. Note the foot deformities and dimpling of the skin over the anterior tibial surface.

soft parts were present, operative interference was carried out on April 4, 1933. Tendo achillis length

Fig 2 Case 1 Roentgenograms of the tibiae and feet of patient shown in Figure 1 when first seen. The calcaneus is displaced posteriorly in both feet.



dimple was present on the anterior surface of each leg at the junction of the middle and lower thirds at the region of greatest bowing. Both great toes appeared normal. On the left foot, two other well defined but syndactylic and shortened digits were present. On the other foot, one broad deformed digit was present in addition to the great toe. On the lateral side of this same foot, midway anteriorly and posteriorly, a small hardened tissue bud could be seen.

Roentgenograms (Fig 2) showed, on this same date, the bowing of the tibiae noted in the physical examination, total absence of both fibulae and of an osseous center for both lower tibial epiphyses. On the left side, the osseous center for the calcaneus, and cuboid were present, the latter two much smaller than normal for this age. The astragalus appeared to be fused with the os calcis. Three normally developed metatarsals were present with their corresponding digits. On the right side, the osseous center for the astragalus on this side was very small and separate from the os calcis. Three well defined metatarsals were present. Corresponding phalanges of the great toe appeared normal but only one set of phalanges was present distal to the other two metatarsals. Because of the fact that the os calcis was riding on the posterior surface of the tibia and such adaptation of the tendons of the tendo achillis and other

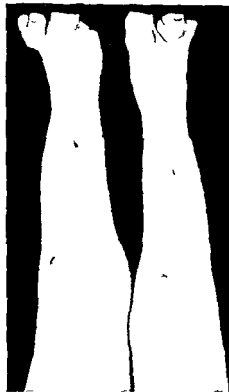


Fig 3 Case 1 Appearance 2 years after operative correction of feet. Satisfactory weight bearing alignment is present.



Fig 4



Fig 5



Fig 6

Fig 4 5 and 6 Case 1 Roentgenograms of the feet taken on the same date as Figure 3 2 years after operation Note the lower tibial epiphysis present in bone and the calcaneus and astragalus fused into one osseous mass in both feet

made at this time and these are reproduced in Figures 4 to 6 inclusive

ening was done on both sides Even after the peroneus longus was lengthened and the peroneus brevis was sectioned on each side it was necessary to open the capsule widely to shift the os calcis and the largely cartilaginous astragalus to the inferior articular surface of the tibia The incisions were closed and boot casts were applied for 6 weeks to maintain correction This was followed by bracing

The patient did not return at regular intervals to the out patient department About 40 per cent of the correction obtained on the right foot was lost in the next 5 months so that it was again necessary to open the right ankle joint laterally on October 4 1934 On this occasion the length of the right tendo achillis was found sufficient but it was necessary to sever the joint capsule and the external lateral ligaments again to place the astragalus and os calcis beneath the right tibia On this occasion cast immobilization with weight bearing was carried out for 3 months Corrective shoes were then given the patient to force the feet into varus During the following 2 years the patient was carefully supervised and the deformity did not lapse Growth has been equal on the two sides

Figure 3 shows this patient's feet 2 years after operative correction Roentgenograms were also

Interesting alterations have occurred when these figures are compared with the original roentgenogram (Fig 2) Practically all of the anterior bowing of the tibia has disappeared An osseous center is now present for both tibial epiphyses but is much smaller than the average size for a 6 year old child The calcaneus is well developed but the astragalus is now fused to the former bone on both sides A pseudo epiphysis (7 8 41) has appeared at the distal end of both first metatarsals In this instance both pseudo epiphyses were far better defined than in most of the cases reported in the literature (8, 39) The other two metatarsals were normal but on the right foot there was an abortive metatarsal that projected into the small skin bud Three small tarsals are now present in each foot The child still has (at 8 years of age) a cosmetic disability because of the relative shortening of the legs in comparison with the thighs The feet are in good weight bearing position and the child walks and plays without any limp He now wears normal shoes

CASE 2 Male was referred to the authors for orthopedic treatment at the age of 11 months When first seen in March, 1935 the deformity of the left foot had been increasing for several months





Fig. 7



Fig. 8

Fig. 7 Case 2 Appearance of foot deformity of patient at age of 11 months  
Fig. 8 Case 2 Roentgenogram taken at the age of 11 months Note that there is no ossification in the lower

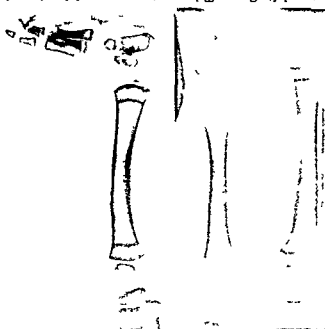


Fig. 9

tibial epiphysis and that the center for the astragalus has not yet appeared  
Fig. 9 Case 2 Appearance of patient at the age of 20 months, 8 months after operative correction of the foot  
teleroentgenograms showed the same discrepancy as originally present in length of the lower extrem

even though there had been no weight bearing  
Physical examination revealed a normal healthy child except for the deformity of the left leg and foot (Fig. 7) The left leg was  $1\frac{1}{2}$  inches (3.2 centimeters) shorter than the right and was slightly less in circumference The fibula could not be palpated The foot was in a position of equinus and marked valgus The ankle joint was relaxed Three well formed and externally normal digits were present Roentgenograms of the left leg and foot (Fig. 8) at this time showed slight anterior bowing of the left tibia The fibula was absent The distal epiphysis of the tibia was not present in bone Only two centers of ossification in the tarsi could be seen, those for the calcaneus and for the cuboid Three metatarsals with their corresponding digits were present Although partial correction could be obtained by casts, the deformity always recurred within a few hours after removal On April 9, 1935, operation was carried out The structures on the lateral side of the ankle joint were exposed The external lateral ligaments were cut One peroneal tendon and the tendo achillis were found taut Both were lengthened A second peroneal tendon could not be found The corrected position was maintained by a cast for the following 3 months during which time the child learned to walk A brace was then fitted to prevent lateral deviation of the foot, and this he has worn since Figure 9 shows the patient 8 months after operation The foot deformity has not lapsed X ray pictures were made at this time (Figs. 10 and 11) Measurements of

Fig. 10 left Case 2 Teleroentgenograms of the tibiae of patient at the age of 20 months The lower tibial epiphysal ossification center has just appeared  
Fig. 11 Case 2 Lateral view of tibia and foot of patient at the age of 20 months The lower tibial epiphysal marking produced by phosphorized cod liver oil lines on the left side as on the normal right side Transverse as much growth at the lower and upper tibial epiphysal patient at the age of 20 months Note that there has been



skeletal anomalies. The data from human sources are meager and unimpressive. In most instances these defects have apparently appeared suddenly in an otherwise healthy stock as have our 3 cases. Vollmann and Debout found the condition to be present in 3 generations. Other authors (38) have stressed the frequent genealogical association of this deformity with other skeletal defects while Hesse states that heredity plays a role in less than 5 per cent of all instances of fibular defects. Friebe found instances in 3 generations including 3 sons in 1 family.

The hypotheses of defects in segmental development (ray defects of Gegenbaur) which have been used to explain many of the congenital deformities in the upper extremity cannot be pressed into service in the instance of this deformity since the missing tissue originates from two or more primitive segments. The reader is referred to the writings of Slingenberg, Gegenbaur, and Haim for the detailed development of this theory. Kanavel has recently urged this theory as an explanation for certain congenital hand deformities.

Once established, the syndrome has a definite evolution which can be seen in our 3 cases as well as in the cases reported in the literature, provided the deformity is not complicated by other congenital anomalies of the lower extremities. The relationship of factors that govern the appearance of the absent fibula syndrome to other anomalies of the lower extremity remains unknown. Lack of function (weight bearing) is not the only factor operative to produce atrophy and shortening in an extremity the seat of this anomaly. For example, our early case demonstrates shortening in both thigh and leg long before the age of weight bearing. The fibular defect varies considerably when all of the reported cases of this anomaly are viewed as a whole. In the majority of cases the whole bone is absent or only an osseous island is present at some point along the expected site of the fibula which is represented by a fibrous band, the peroneal ligament. The important essential defect in the pathogenesis of subsequent deformity is the lack of an external malleolus which allows lateral and posterior luxation of the foot.

Characteristic in the development of a leg with this deformity is the delay in ossification and development of the lower tibial epiphysis and certain of the tarsal bones, metatarsals, and corresponding phalanges. The appearance time of ossification in the lower tibial epiphysis may be additionally delayed by lack of function. For example, in Case 1, which had been neglected, this center did not appear in both limbs until between the ages of 4 and 5, while in Case 2 where early weight bearing was obtained this center appeared at 20 months. The centers for the astragalus and calcaneus appear in the deformed limb early but are likewise slightly delayed in ossification since in our youngest case only a center was present for the calcaneus at the age of 11 months while the center for the astragalus appeared between the ages of 11 and 20 months. In our cases there appears to be failure of development of the subastragalar joint. Early fusion of the osseous centers for the calcaneus and astragalus occurs, the exact time of which is difficult to estimate from the examination of roentgenograms alone. It appears (Fig 11) that fusion may have begun at the age of 20 months in our Case 2, while in our case of bilateral occurrence of the deformity, fusion seems not to have been accomplished on both sides until the age of 8 years. In our dissected amputation specimen, the astragalus and calcaneus were found *en bloc*. This also was the experience of Wagstaffe who examined a postmortem specimen from a man 45 years of age and of Dieulafe and Cahuzac who have recorded the only other description of a dissected amputation specimen (patient aged 60 years) that we have been able to find in the literature. Reproductions of roentgenograms in reports of others likewise show the astragalus and calcaneus as a single bony mass. The occurrence of the other tarsal bones seems to be irregular. However, the almost constant presence of the cuboid is another fragment of evidence against this being a purely segmental anomaly.

One or two metatarsals with their corresponding phalanges are usually absent. The most common finding among the cases in the literature is that present in our Cases 2 and 3 and in the left foot of our Case 1. The pres-

The extent of the pathological process and its anatomic location determined whether the later developing foot was to show congenital amputation, clubbing, hypodactylism, or syndactylism. Bonnevie in an extended series of experiments has confirmed the above findings. On the other hand, she has been able to show that the bieb on the extremities originates from an excess of cerebrospinal fluid. Thus, such anomalies of the extremities may have a complex pathogenesis, although the underlying hereditary principles are the same.

#### TREATMENT

The orthopedic management of this compound deformity varies with the extent of the deformity and the age of the patient and whether the defect is unilateral or bilateral. Interference is directed at the equinovarus foot deformity and at the bowing and shortening of the tibia. Although not recognized by the majority of previous authors, growth potentiality for the lower tibia on the diseased side must be considered. The importance of this last factor is illustrated by the results in our early unilateral case.

Cornet stated, "Patients can get on quite well without the fibula, and lead long useful lives." Inspection of the reports alluded to by this author revealed that most (3 of 5) of these adult patients had many congenital anomalies, some in all four limbs, and thus do not come under the scope of this subject. Their appearance was far from normal and it is difficult to see how they could "have got on quite well." The older patients with absence of the fibula demonstrate only the advanced deformity that results from many years of neglect. In the 1 adult case of 45 years and in 2 children described by Wagstaffe, the foot on the affected side was pulled laterally upon the posterior surface of the tibia and fixed there by contractures. Schaff reported a thorough clinical study of a man 40 years of age who had carried the deformity without treatment. His photographs show an extreme equinovarus deformity with posterior luxation of the foot. There were 10 centimeters of shortening of the lower limb measured from knee to the internal malleolus. Dieulafoy and Cahuzac's patient (aged 60) had only a 5

ence of the cuboid and the configuration of the most lateral of these metatarsals suggests the absence of metatarsals two and three. Examination of our amputation specimen furnishes additional evidence for this conclusion since the structure of the lateral metatarsal is identical with the normal fifth metatarsal. Wagstaffe's findings were similar. This is not the only configuration of the foot that may be associated with absence of all or a part of the fibula. In the majority of the cases from the literature and in the right foot of our Case 1 there appear skin tags upon the lateral surface of the foot that contain small osseous fragments. When these fragments are present, the configuration of the other metatarsals suggests that the lateral metatarsals and corresponding phalanges are the missing members. In a few instances there are bidd phalanges and reduplicated phalanges distal to a single metatarsal and in a few instances a normal number of metatarsals and phalanges is present. This variability in development of the foot with constant deformity of the fibula constitutes further evidence against the application of the segmental hypothesis of Gegenbaur to this syndrome of bone anomalies. In the field of experimental zoology, Bags has shed new light on the etiology of congenital defects as having an origin in injury to the germ plasma occurring even before mating. So important are these findings that we will briefly review them in this place. This author was able to produce certain deformities of the feet in mice by light doses of x-ray. The descendants of animals so treated showed a high percentage of abnormalities of the limbs, mainly expressed in various forms of club feet, syndactylism, hypodactylism, congenital amputations, and polydactylism. He further found that selection in mating of the descendants of these animals increased the number with foot defects. Abnormalities of the limbs were found to be recessive in inheritance. Embryological studies showed that the earliest foot defect was associated with the formation of a blister-like bieb, which raised the epitheliums of the foot usually in a localized area, followed by the escape of blood into the bieb and formation of a localized

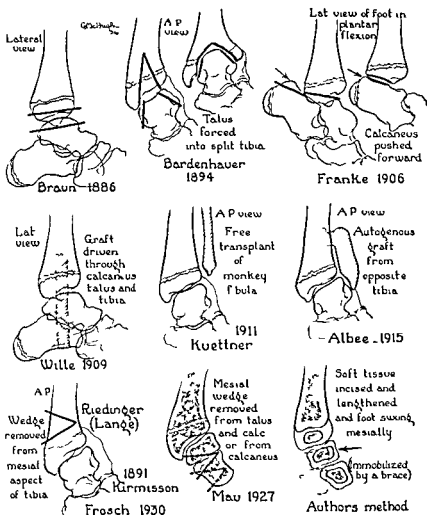


Fig 10 Methods advocated for stabilization and correction of equinovagis deformity resulting from congenital absence of the fibula. See text for discussion

centimeter discrepancy in leg length, all confined to the leg but the foot was externally and laterally displaced about 40 degrees

The methods of treatment described in the literature (Fig 16) are chiefly cast correction of the foot deformity, osteotomy of the tibia to correct bowing, and lengthening of the tendo achillis and peroneal tendons to allow correction of the equinovagis. The necessity of accessory capsulotomy at the ankle joint has not been frequently mentioned. Braun performed an arthrodesis of the ankle joint with the foot in equinus. Volkmann, Riedinger, and others (15, 26) advocated cuneiform supramalleolar osteotomy to correct the foot

deformity. In a few cases treated in this way, non union occurred. As a result, Mau urged that the wedge should be removed from the astragalocalcaneal region. The cosmetic results showed by this latter author commend this procedure whenever uncorrectable lateral foot displacement is encountered. Bardenhauer advocated splitting the lower end of the tibia and implanting the astragalus into it. Franke performed a fusion of the posterior surface of the calcaneus with the inferior surface of the tibia. Kuettner transplanted, as a free graft, the fibula of a monkey. This was said to have been successful in forming a lateral malleolus but a later report of results

5 years after operation, revealed that the fibula had not grown. Indeed, reproductions of roentgenograms in this author's last paper suggest from the sharpness of outline of the transplant that it was only a functional sequestrum in the soft tissues. Corner believed that all operative treatment for correction of the condition was futile because of associated deformities. He stated that amputation was frequently necessary. Gænslen used only a high shoe with an inner wedge for a 7 year old girl with nearly 7 centimeters of shortening. Albee (1) used bone from the opposite deformed tibia to reconstruct an external malleolus. This graft extended laterally and inferiorly from the lower tibial metaphysis.

In many of the above reports, the possible end results of damage to the lower tibial epiphysis by extensive operative procedure have been completely ignored and therefore must be condemned as physiologically unsound. In the recent work of Pfenmister it is again emphasized that the operative interference, including the placing of a bone graft across an epiphyseal line, usually results in cancellation of longitudinal growth at that epiphysis. Thus, the methods of Bardenheuer and Wille could not be applied until adolescence. It is certain that arthrodesis as advocated by Bran and Franke could not be carried out much before the age of 8 or 10 years without danger of arrestment of longitudinal growth from the lower tibial epiphysis since the osseous development of that epiphysis is greatly delayed. Upon the theoretical grounds, the operation advocated by Albee is unsound for young children, since the newly constructed lateral malleolus will ascend with longitudinal growth. Absorptive changes, moreover, will take place on the free surfaces of the graft. If the graft fuses across the epiphyseal line, progressive ankle deformity will occur. Turner has recently demonstrated actual specimens showing such deformities at the ankle joint in adults treated in this way in childhood. We have found in the literature only 2 reports of the late results obtained by the procedures previously mentioned and thus cannot demonstrate all the deformities that would certainly follow. Haas, however, re-

ported a satisfactory end-result of a well aligned limb 20 years after having carried out an operation similar to that described by Albee. Waterman observed a patient at 12 years of age upon whom the Bardenheuer procedure had been performed at the age of 1. While condemning the procedure as unacceptably having interfered with longitudinal growth at the lower end of the tibia, the observed discrepancy in leg length at the time of 7 years after an operation implanting a graft from the lower ulnar shaft to the carpus for congenital absence of the radius, Albee (2) stated that function was good. Roentgenograms showed increased radial deviation and detachment of graft from the carpus, presumably by the impetus of longitudinal growth. We would restrict interference in this deformity to those methods that are physiologically sound. We recommend in children that the foot be aligned with the tibia for weight bearing. This should be done as early as the child can be seen. If cast correction fails, as it did in the 2 cases of our series where this was first carried out, operative replacement of the foot is indicated. Cognizance must be taken that the calcaneus is frequently as high as the posterior surface of the tibia as well as being displaced laterally. Lengthening of the posterior and lateral structures must be done, usually with capsulotomy. Special care must be taken not to damage the lower tibial epiphysis or the astragalus since at an early age these are largely cartilaginous. Cast immobilization in a slightly overcorrected position (Case 2) is carried out for at least 6 weeks. Weight bearing may be started as soon as a week after the operation. After removal of the cast, a short leg brace to maintain correction is frequently necessary. Constant and early weight bearing is advised to act as a stimulus to longitudinal growth. Our Cases 1 and 3, as well as many of the cases already reported in the literature demonstrate the neglect of early weight bearing. It cannot be stated at this time how much of the shortening seen in older cases is due solely to such neglect. We do not believe that arthrodesis of the lower tibial epiphysis with the astragalus is always necessary to establish

**lateral stability of the ankle** If lateral instability is a prominent feature in the later management of these cases either bracing or arthrodesis of the tibio astragalar joint can be done. If the latter is preferred, the operation must be delayed until an adequately large ossification center is developed so that the operation can be executed without danger of damage to the epiphyseal cartilage plate. In older cases (10 years or more), if sufficient anterior bow of the tibia remains, this can be corrected by osteotomy with minimal excision of bone, because of the ever present danger of non union. Most of the cases presenting this deformity below this age will straighten spontaneously if early weight bearing is carried out.

**Equalization in leg length in older patients** (beyond the age of 10 years) is a problem only if the deformity is unilateral and if the shortening is not too great. Case 1 of our series has a normal walking gait since the condition is present in both limbs (Fig. 3). The means of equalization of leg length will vary with individual preferences. A high shoe, or orthopedic prosthesis can be used. Operative arrestment of longitudinal growth of the sound extremity at a suitable age by epiphyseo-diaphyseal fusion (3,6) can be considered but will be feasible only in persons of normally advanced height.

In many cases shortening of the sound limb by this method or by actual excision of diaphyseal bone is not suitable since such procedures would result in too much loss of total height. Thus such cases can always be best treated by low leg amputation in the pre-adolescent period and the fitting of a suitable prosthesis (Case 3). Periodic observations of both tibias by the roentgen ray after the production of phosphorus lines (Case 2) will furnish information on longitudinal growth that will be a guide to subsequent treatment. Leg lengthening can be considered by one skilled in this procedure in adolescents or young adults of short stature where the discrepancy is not too great.

#### SUMMARY AND CONCLUSIONS

1. Three representative cases illustrative of various problems in the treatment of the

syndrome associated with congenital absence of the fibula are reported.

2. The embryological basis and the natural evolution of this compound deformity in the growing child are described. The defect is probably one of the germ plasma affecting the limb bud. Evidence is given that associated defects in the foot are not always constant. Roentgenographic studies and dissection of one amputation specimen shows that the defect is not entirely one of the outer portion of the limb bud.

3. Many of the methods of treatment advocated in the literature are physiologically unsound. We have pointed out the procedures that are applicable in the treatment of this condition.

**ADDENDUM** While this article was in press, the authors, through the courtesy of Dr. Gerald M. Green, have seen an additional bilateral case in the wards of the Cook County Children's Hospital. The feet were similar in appearance to those in our Case 1 except that four well formed metatarsals were present in one foot, with the usual three in the other.

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# PENTOTHAL SODIUM FOR INTRAVENOUS ANESTHESIA

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WHEN it has been decided that surgical intervention is required, the choice of the anesthetic agent and the method of its administration suited to the particular case becomes important from the standpoint of comfort and safety of the patient. A proper choice of anesthetic will facilitate the surgical procedure. Special methods of anesthesia have received more attention in recent years as new anesthetic agents and apparatus for their administration have become available, in addition, requests for the employment of such special methods have become more frequent.

The way in which enthusiasm for intravenous anesthesia is growing is remarkable. Requests for anesthesia by this method are increasing in frequency both from patients who have experienced this type of narcosis and from surgeons. Pentothal sodium (sodium ethyl, 1-methyl butyl thiobarbituric acid) (3) is one of the newer derivatives of barbituric acid which is suitable for this type of anesthesia. It differs from pentobarbital sodium (nembutal) in that one atom of oxygen has been replaced by an atom of sulphur on the urea side of the molecule (Fig. 1). Pentothal sodium is available in crystalline form in ampuls containing 1 gram of the drug. A 5 per cent aqueous solution is prepared prior to administration, the distilled water being supplied in companion ampuls. A large caudal needle is used for mixing and aspirating the solution into a 20 cubic centimeter syringe. For injection, an 18 or 20 gauge needle is used. The prepared solution of pentothal sodium should be pale greenish yellow and it should be clear. It has a slight odor of sulphur.

Satisfactory sedation may be obtained by the preliminary administration of  $\frac{1}{6}$  grain (0.01 gram) morphine sulphate and  $1\frac{1}{2}$  grains (0.097 gram) of pentobarbital sodium. For minor surgical procedures preliminary medi-

cation may be omitted. If intravenous anesthesia is likely to be supplemented by inhalation anesthesia, it is advisable to administer  $1/150$  grain (0.0004 gram) of atropine sulphate half an hour prior to operation.

While the patient is being prepared and draped for operation in the usual manner, the anesthetist may determine which superficial vein he will use for the injection. The cubital veins are usually the most prominent and accessible. The arm is placed on a well padded board and is secured in position by a turn of adhesive tape. If the cubital veins are not easily accessible, it may be feasible to use a vein on the back of the hand. The skin is sterilized with alcohol, a tourniquet is applied, the patient is asked to clench his fist, and the needle is inserted. When the vein is entered, the tourniquet is loosened and the injection is begun. The patient is then asked to count slowly and distinctly. The average adult is given an initial dose not exceeding 4 cubic centimeters of a 5 per cent solution, which is injected in from 15 to 25 seconds. The patient seldom is able to count beyond 20. The operative procedure may now be started as, at this point, surgical anesthesia with a fair degree of relaxation should be attained. If the patient winces a little or mutters, 0.5 to 1 cubic centimeter more of the drug should be injected. The needle is kept in the vein throughout the operation and 0.5 to 1 cubic centimeter is injected from time to time as indicated by signs of lightening anesthesia. It is helpful to inject a very small amount at intervals in order to clear the needle, otherwise the needle may clog and it will be necessary to reinsert it. Respiration is the best single guide for evaluating the depth of anesthesia. There may be slight movement of the feet or phonation may indicate that more of the drug is needed.

As depression of respiration is one of the main effects produced by the drug, it is essential that a free airway (2) be constantly maintained, and to this end it is necessary to have

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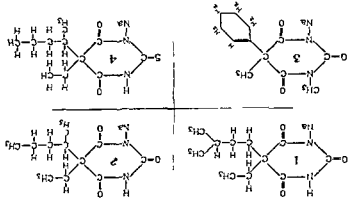


Fig. 1 Progress in the production of shorter acting barbitals, (1) sodium amylal, (2) nembutal, (3) barbital sodium, (4) pentobarbital sodium

able to administer nitrous oxide and oxygen, or cyclopropane and oxygen, for, if emesis should ensue, a breath or two of pure oxygen will restore the laryngeal reflexes and the patient will be able to protect himself against aspiration of foreign material.

Unpleasant symptoms during induction of anesthesia with pentothal sodium are seldom experienced. Patients, when questioned afterward, tell only of a sleepy sensation, which was not unpleasant to them, and they remember nothing further until they recover from the anesthesia. Struggling or restlessness is seldom exhibited, and only very occasionally is a slight tremor noted. During anesthesia the patient is apparently in a deep, quiet sleep with regular shallow breathing, on recovery, nausea or restlessness is seldom encountered. Frequently the patient will begin counting again when he is left off during induction, but he soon becomes oriented and remembers nothing of what took place in the interim. There are, however, some features of the recovery period that resemble mild alcoholic intoxication, and this is usually in proportion to the amount of the drug used during anesthesia. These signs and symptoms may persist in a mild degree for some little time after recovery, and it is best not to allow the ambulatory patient to leave the hospital unaccompanied or to drive his own car.

Pentothal sodium produces satisfactory surgical anesthesia for many procedures, for example, drainage of abscesses, biopsy, cystoscopy (6) and uterine catheterization, dilatation and curettage, operations on the eye-

the services of an assistant during administration. It is the assistant's duty to elevate the relaxed jaw or to insert an artificial airway should this be necessary to facilitate respiration. The assistant should carefully observe actual exchange of air. He should ascertain the rate of the pulse, and blood pressure readings should be obtained frequently. He should be prepared to administer oxygen if respiration becomes inefficient or if any degree of cyanosis develops. This method of administering the anesthetic as outlined overcomes to a certain degree the objection that an injected dose of the anesthetic agent is not recoverable, for the agent is broken down rapidly in the body and, by injecting small fractional doses, administration is comparable to that of ether by the open drop method. Dosage is not calculated on the basis of body weight, the amount of anesthetic injected being governed by the physiologic response and the usual signs of anesthesia. The initial injection should be reduced for debilitated or aged individuals, and in such cases administration should be undertaken slowly and cautiously, respiration being carefully observed.

Intravenous anesthesia is contra-indicated in cases in which there is respiratory embarrassment due to cardiac decompensation, bronchiectasis, or advanced pulmonary tuberculosis. Dyspnea from any cause should contra-indicate the administration of pentothal sodium. A general anesthetic agent of any kind should be avoided if food has been ingested within 3 hours of the time of operation, however, if intravenous anesthesia is desired and it is not possible first to wash out the stomach, the following suggestion may prove helpful. Put the table in a slight Trendelenburg position, have a suction tip at hand, have a gas machine equipped with carbon dioxide and oxygen available, and finally, keep the patient in fairly deep anesthesia during the surgical procedure. With intravenous anesthesia the reflexes of the pharynx and larynx are obtunded to a greater degree than when nitrous oxide and oxygen is employed. If general anesthesia is necessary when the patient's stomach is not empty, it is preferable-

TABLE I—INTRAVENOUS ANESTHESIA WITH PENTOTHAL SODIUM\* (JUNE 18, 1934, TO JUNE 1, 1936)

		1936	1935	1934
1	Operations on brain spinal cord and peripheral nerves	59	76	3
2	Operations on eye	30	57	20
3	Operations on head and neck (other than the above)	117	276	9
4	Dental extractions	15	33	2
5	Transurethral and cystoscopic operations and manipulations	237	458	25
6	Orthopedic operations	26	44	1
7	Operations on thorax thoracic wall breast and axilla	77	158	1
8	Digestive system operations	2	9	
9	Operations on the large bowel	40	40	7
10	Intra abdominal operations	2	8	
11	Operations on abdominal wall and for hernia	23	23	
12	Gynecological operations	170	147	4
13	Operations on anus	21	10	1
14	Total	819	1133	73

\*Distribution of cases in which pentothal sodium was used either to induce anesthesia or maintain it according to the type of surgery that was done

(including adjustment of muscles or enucleation), dental extraction, removal of packs, and many minor procedures. However, there is usually not sufficient relaxation with this agent to facilitate intra abdominal procedures, although pentothal sodium may be used to induce general anesthesia.

Intravenous anesthesia is useful when a nodule is to be removed from a breast, the type of surgical procedure then being determined by the report of the surgical pathologist at the time of operation. The patient might be informed beforehand that, if the condition proved to be more serious than expected, a more radical procedure would be carried out. The nodule can easily be removed under intravenous anesthesia and, if the condition should prove to be malignant, inhalation anesthesia would carry the patient satisfactorily for the longer radical procedure, in this way the patient would not know of the more serious diagnosis during operation, as would be the case if local anesthesia were employed. The intravenous agent provides for an easy induction and when supplemented by

inhalation anesthesia, the transition is smooth and quiet. We believe that this method is superior to local anesthesia, for the discomfort of the infiltrating needle is avoided as well as the possibility of producing metastasis through mechanical interference if the condition is malignant. If the nodule proves to be benign, intravenous anesthesia is adequate for the entire procedure even though simple amputation of the breast is indicated.

With pentothal sodium easily and immediately available in an operating room, it may be used in the control of convulsive states occurring during anesthesia produced by other agents. Pentothal sodium has been successfully used, for example, in the control of convulsions produced when a large amount (8 cubic centimeters of a 10 per cent solution) of cocaine was injected subcutaneously. For convulsive states encountered occasionally during the administration of agents capable of producing general anesthesia, the initial untoward reaction may be controlled by the intravenous administration of either evipal soluble or pentothal sodium. Because elimination of the agent responsible for the convulsions may be a prolonged process, it is well to change when possible to the use of longer acting barbiturates, such as nembutal or sodium amylal. This is true, also, in the case of convulsions encountered in eclampsia (7), tetanus (4), or poisoning from strychnine (5).

Pentothal sodium may also be used as a prognostic agent (1). Following its intravenous administration, the temperature of the extremities rises to the maximal point. If in a case of Raynaud's disease the temperature of the fingers fails to reach 35 degrees C, one may conclude that some peripheral vascular condition exists and that section of the cervicothoracic sympathetic nerves will not completely relieve the condition. In cases of essential hypertension, the lowest point to which the blood pressure falls during injection of a dose of the drug sufficient to produce a maximal rise in the temperature of the extremities fairly well indicates the point to which the blood pressure will fall following neurosurgical intervention. The operation performed in cases in which patients respond satisfactorily to this test is two stage bilateral

comparable to that obtained when ether is administered by the semi-open drop method. Recovery is rapid and is not associated with nausea or undue restlessness. The drug is less well tolerated by children than by adults. It may be employed for operations of short duration when thorough relaxation is not essential. Pentothal sodium is a potent drug and should be administered by an experienced anesthetist capable of dealing with problems that may develop during general anesthesia.

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resection of the splanchnic nerves, first and second lumbar ganglions and connecting ram, and partial resection through modified bid-mey incisions of the celiac ganglions and suprarenal glands. For this test, the average adult dose is 15 cubic centimeters of a 5 per cent solution of pentothal sodium injected in approximately 15 minutes. A thermocouple is attached to each of two or three toes of each foot. Injection is continued intermittently until the temperatures reach a maximum. The blood pressure and temperature of the skin are determined every 2 minutes during anesthesia. Usually the maximal skin temperature is attained within 15 minutes. The "preoperative prediction values" are the lowest systolic and the lowest diastolic pressures obtained during the test.

From June 18, 1934, to July 20, 1936, pentothal sodium was employed for the production of anesthesia 2,700 times. Distribution of the cases for these years according to the type of operation performed may be noted in Table I. Experience gained permits the following conclusions. Pentothal sodium is the most effective short acting barbiturate that has come to our attention. The drug is so rapidly destroyed within the body that intermittent administration throughout the operation permits control of the depth of anesthesia.

# CERTAIN CHEMICAL FACTORS IN EXPERIMENTAL HIGH INTESTINAL OBSTRUCTION

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**H**IGH intestinal obstruction in dogs is associated with a short duration of life. Haden and Orr (5) found that with obstruction to the upper jejunum the average duration of life was 68 days. Wangenstein reported a survival period of from 3 to 4 days and Dragstedt and Moorhead noted that animals with an obstruction just below the pancreatic duct lived only 96 hours. It is generally accepted that the symptoms in intestinal obstruction are due to some toxic agent which develops soon after obstruction begins. Tileston and Comfort, and Cooke, Rodenbaugh and Whipple noted that there is a gradual increase in the non protein nitrogen and urea nitrogen. Draper adds a finding of a high uric acid value in one dog just previous to death. Haden and Orr (5) have also shown that in high intestinal obstruction there is a progressive alkalosis and a remarkable fall in chlorides due possibly to the utilization of the chlorine ion in the course of the intoxication. MacCallum, Lintz, Vermyle, Legget and Boas also demonstrated a similar drop in the chlorides after section of the pylorus in dogs and McCann found that following operations on the stomach which exclude acid from the duodenum, tetany develops which simulates parathyroid tetany. Hastings, Murray and Murray have also made studies on dogs after ligation of the pylorus. They found a progressive alkalosis, a slightly elevated calcium content and a decrease of sodium and chlorine electrolytes. It is suggested that these changes in the blood chemistry may account for some of the symptoms in the animals with high intestinal obstruction.

A new aspect to this problem has been introduced by Johnstone, Clasen and Orr who have shown that animals survive for as long as 23 5 days with a high jejunal obstruction if

the portion of the gut containing the major pancreatic duct is transplanted to an area below the obstruction. This result closely parallels the work of Eisberg and Draper and of Jenkins in which sections of liver, duodenum and pancreas are drained into the jejunum below the site of the obstruction. The work of Haden and Orr (6) showed, moreover, that if the jejunum is divided and its proximal end drained to the outside, dogs die as quickly as if the jejunum had been obstructed. It would appear then that the secretions of the various organs into, and from the small bowel are essential to life.

This problem has intrigued us from two different aspects: (1) the possible nature of the toxemia, and (2) the relation of the absorption mechanism in the intestine itself.

The first group of experiments concerns itself with tying off various portions of the duodenum in dogs above and below the pancreatic ducts as in Figure 1.

Several normal healthy dogs were chosen which had been kept on a high carbohydrate, low fat diet with protein in moderate amounts for 2 weeks. Under nembutal anesthesia the abdomen of a fasting animal was opened and an area of the duodenum chosen for occlusion. Into this area dextrose and sodium chloride solutions were injected. Careful attention was observed so that the blood and nerve supply were not interfered with. As the results were consistent they are represented in the accompanying tables for the entire group.

It will be noted that, after either dextrose or saline is placed in area I, the rates and the amounts of absorption are much less than if the solutions are injected in either areas II or III. Furthermore, if dextrose is injected in area I only a negligible amount of it appears to be absorbed. This would lead one to believe that in order for satisfactory absorption to take place the injected fluid must be mixed with the secretions going through the pan-

TABLE I—PORTAL VEIN DEXTROSE VALUES (MG. PER CENT) AFTER INJECTION OF 20 C CM OF 5 PER CENT DEXTROSE INTO THE AREAS OUTLINED IN FIGURE 1

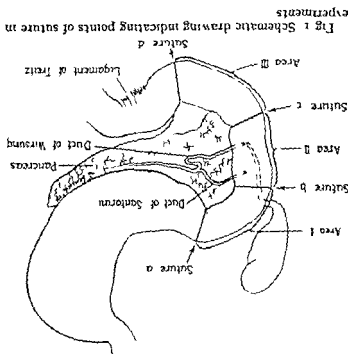
Pre injection value	5 min	10 min	20 min	40 min
Area I	102	104	100	118
Area II	104	105	120	148
Area III	95	101	170	151

TABLE II—PORTAL VEIN CHLORIDE VALUES (MG. PER CENT) AFTER THE INJECTION OF 40 C CM OF 9 PER CENT SODIUM CHLORIDE

Pre injection value	5 min	10 min	20 min	40 min	60 min
Area I	465	460	500	510	504
Area II	500	520	584	590	620
Area III	480	515	570	540	550

TABLE III—RISE IN SERUM VALUES FOLLOWING OBSTRUCTION AT (D)

Dog No	Day after operation	Blood values (mgm per cent)			CO <sub>2</sub> Content (in cm per 100 cc)			Death end of sixth day		
		Proteins	Chlorides	N.P.V.	Proteins	Chlorides	N.P.V.	4	64	81
I	1	17	4.0	26	10	60	48	3	43	48
	2	28	3.0	30	41	60	48	3	43	48
	3	36	3.0	30	87	100	51	3	43	48
	4	56	2.8	100				3	43	48
II	1	21	5.0	22	36	70	42	1	10	25
	2	44	3.0	70	91	54	42	3	26	62
	3	71	2.6	91				1	10	25
	4	64	3.8	98				3	43	48
III	1	10	3.0	35	42	50	42	1	10	25
	2	26	4.0	62	44	50	42	3	43	48
	3	43	4.0	410	71	48	48	3	43	48
	4	64	3.8	98				3	43	48



large extent on the fluids produced by the pancreas and liver. This may explain in part the reasons why high intestinal obstruction is so disastrous to animal life. On the other hand, this would by no means explain the rapid loss of chlorides from the animal body, such as is seen in high intestinal obstruction, because by simple starvation the survival period is much longer. Obstruction just above the ligament of Treitz, equivalent to area III was carried out in 3 dogs. The dogs failed to live longer than 4 days (Table III). We were struck by the fact that not only was there a remarkable drop in the blood chlorides but that there was an increase in the blood potassium. The blood calcium values (not given in the table) varied but little. The increase in the blood potassium is of about the same magnitude as is found following adrenalectomy. Other dogs in which this same procedure was carried out were given potassium chloride intravenously, and death was precipitated within an hour after the injection of 10 cubic centimeters of 1 per cent potassium chloride, an amount which is tolerated by normal dogs. In short, we were led to believe that this increase in the plasma potassium content might account for a considerable extent for the moribund condition present in the animals and possibly for the death of these animals. The non-protein nitrogen and the progressive

creatic duct containing both pancreatic juice and bile or liver ferments. It appears, moreover, that if area III is obstructed from area II the rate of absorption is decreased. If, however, area II and area III are not separated by an obstructing band the rates of absorption not represented in the tables will be the same as in area II. Intestinal obstruction, therefore, in the small bowel must depend to a

alkalosis are referred to merely as confirmatory findings. Hastings and Compere in 1931 called attention to the fact that, after adrenalectomy, a rise in potassium may account for the death of the animal. The findings that we have presented might in some way be of a similar nature.

### CONCLUSIONS

High intestinal obstruction is associated with the factor of delayed absorption of material from the duodenum. The liver and pancreatic juices play a rôle in the absorption of dextrose and saline from the intestine. There is a definite increase in the blood potassium following high intestinal obstruction which may in some measure play a rôle as one of the contributory factors in the cause of death in these animals.

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# PITRESSIN (BETA-HYPOPHAMINE) IN LAPAROTOMIES

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KALLI, in 1928, separated an extract of the posterior pituitary gland into two active principles, which he called pitocin and pitressin. Pitocin, the oxytocic factor, has little effect other than its power to increase contraction of uterine muscle. Pitressin, however, has several other effects which vary somewhat in animals and in man. The three most important in man are (1) the stimulation of intestinal peristalsis, (2) the reduction of kidney excretion, and (3) the pressor influence on the cardiovascular system. Since these three effects are bound up in their relative importance before using pitressin the pressor fraction, it is necessary to evaluate their relative importance before using pitressin clinically.

## THE EFFECT OF PITRESSIN ON THE INTESTINE

Some physiologists have shown that the effect of pituitrin and pitressin on the intestine of the dog is largely one of inhibition (21, 32, 45, 46, 49). Some have reported increased activity, this varying according to the animal, the dosage, and the experimental conditions, but occurring rather uniformly in the rabbit (13, 14, 24, 33, 34). Dale claims that pituitrin acts directly on intestinal muscle without any relation to innervation. Pancoast and Hopkins, in careful observations on humans with a barium meal, found no very important changes in gastro-intestinal motility.

In spite of the inhibitory effect on the intestine of the dog, its power to aid in the expulsion of gas in the human is a recognized clinical fact. Bell was one of the first to report the efficacy of pituitrin in the treatment of postoperative distention. Innumerable reports have followed. H. A. Carlson, by making use of balloons in colostomized patients, showed that pituitrin stimulates the intestine from the cecum to the sigmoid. The small waves are respiratory movements, the large ones bowel contractions. Readings at the bottom indicate the pressure of the gas in the intestine.

Pitressin not only contains the intestine activating factor in posterior pituitary extracts, but in addition it seems more active in this respect than the whole extract. Alleville (33) and Blumer and his associates think that the oxytocic factor is antagonistic to this action of the pressor factor. The oxytocic factor in the surgical use of pituitary extracts is not necessary, but from a theoretical as well as a practical point of view the use of pitressin in abdominal distention is preferable to that of the whole extract.

Because of this controversy regarding the pitressin effect on peristalsis, we devised a simple experiment to determine its effect upon the human colon. Several hours after the bowel has been cleared out by an enema, a large stomach tube is inserted into the rectum, and the colon is inflated with air to the point of mild discomfort. Usually 500 to 1000 cubic centimeters of air suffice. The tube is then attached by a Y connection to both a water manometer, from which readings can be taken directly, and a tambour which records changes in intracolonic pressure on a smoked drum. Figure 1 is the record of such an experiment. The small waves are respiratory movements, the large ones bowel contractions. Readings at the bottom indicate the pressure of the gas in the intestine.

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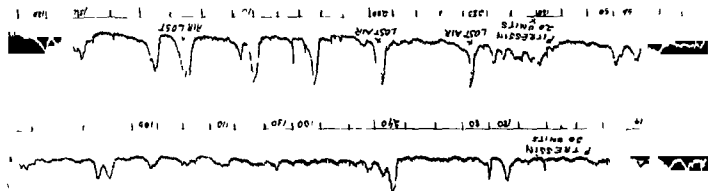


Fig. 1.  $\lambda$  -  $\lambda$  of the intercapillary pressure of a normal animal in a state of rest. The small excursions are respiratory waves, the larger ones are peristaltic waves. The time is marked in minutes. The figures below the base line represent the height of contractions above them in millimeters of water. The first

injection of pituitary hormone was followed by a sharp intensification of distress in the second injection of pituitary hormone. After the first one, again brings no, about 2 minutes, violent contractions which are accompanied by sharp subjective distress.

blood pressure, pain in the abdomen, and difficulty in breathing. He seems to attach little importance to them. Potter (42), in his series of 1,200 cases in which 20 units were used routinely, found that blanching of the face and extremities without changes in the blood pressure or pulse rate was of frequent occurrence. Occasionally a patient vomited following every injection. This has also been our experience. In addition, he encountered a few cases of rather severe shock, which he thought was due to the drug entering the blood stream

ing every injection. This has also been our experience. In addition, he encountered no cases of rather severe shock, which he thought was due to the drug entering the blood stream directly. This is a possibility and it due to cardiac weakness could be promptly controlled by the use of epinephrine or epinephrine, both of which abolish the diminution of cardiac output due to distress.

output due to pitressin

attributed to the cardiac effect of the drug

First, an elderly man with diverticulitis went

PHOTOS & ILLUSTRATIONS BY JAMES H. HARRIS

injection of 20 units in 2 hours, but he quickly

10 years, with a 25% increase in the number of people aged 65 and over.

HOWEVER, SINCE OF 10 LAMBS REMAINED ALIVE

8 101 YUEN SAHUN 3 ANGER SAHUN 01 HEANG SAH

an excellent recovery from a severe pneumonia

but died on the thirteenth day of heart trou-

ble. At autopsy the abdomen appeared de-

fectly clean. Death was due to coronary

sclerosis and myomalacia of the ventricle. It

is probable that the pitressin did not cause the

pathological condition, but it certainly was

potentially dangerous

TABLE I—AVERAGE FLUID AND CHLORIDE INTAKE AND OUTPUT FOR FIRST 18 HOURS AFTER OPERATION IN 16 CONTROLS AND 16 ROUTINE PITRESSIN CASES

	Fluid intake	Chloride intake	Urinary output	Chloride output	Chloride concentration per cent
Controls	2274	9.5	402	2.1	0.6
Pitressin series	2300	9.34	336	2.0	0.8

**Conclusion** The blood pressure generally rises after an injection of pitressin, but the rise is not large or long sustained, while the deleterious effects of pitressin on the heart or blood pressure do not occur with ordinary therapeutic doses, one should hesitate to use large or repeated doses in an old man who shows evidence of coronary sclerosis. These effects are very marked on intravenous injection and for this reason this route of administration is not advisable.

#### INFLUENCE ON URINARY OUTPUT

The vasopressor principle in posterior pituitary extracts contains an antidiuretic factor. Pitressin has been reported to have both a diuretic and an antidiuretic effect. Geiling thinks that its antidiuretic effect is in all likelihood its normal action, and that diuresis is the result of variations in the experimental conditions. MacDonald from experiments on man and animals concludes that the diuretic action, if it occurs, is always associated with a rise in blood pressure and is always followed by an antidiuretic effect.

In man the effect is always antidiuretic, never diuretic. If a normal individual is given a liter of water, and then an injection of even less than the therapeutic dose of pitressin, the expected diuresis is delayed and diminished for a number of hours (6, 15, 50). This action is probably due to an increased absorption of water from the loops of Henle (7, 18). At least it is a pure renal effect with no alteration in water absorption and is followed by a compensatory diuresis (31). The chloride excretion may be increased (31, 44, 51). Dieckmann and Michel found in normal pregnant women a decrease in the volume of urine, and an increase in chloride concentration, in pre-

TABLE II—URINARY OUTPUT IN SECOND SERIES, 38 PATIENTS

	First day		Second day	
	Fluid intake	Urinary output	Fluid intake	Urinary output
Controls	2093	453	2002	701
Pitressin series	2115	477	2460	612

eclamptic women the reduction in urinary volume was very marked.

Since a reduction in urinary output is harmful in a patient who has been operated upon it is necessary to investigate the matter. Table I is self explanatory. Sixteen controls with similar operations are compared with 16 cases receiving pitressin routinely before operation and every 4 hours thereafter. The urinary output for the first 18 hours is diminished, the chloride output is the same, the chloride concentration is increased. The data in this series are reasonably accurate and correspond closely to experimental findings.

In Table II the daily urinary output of a second series of 38 patients in whom pitressin had been used routinely every 4 hours is compared with a similar series of controls. For the first day the figures are approximately the same. On the second day there is a diminution of urinary output in the pitressin series. These figures may be a bit misleading in view of the fact that the patients were not as closely supervised, and there were a number with constant gastric siphonage, in whom the fluid output through the stomach tube was not calculated. The urinary output of patients who had from 3, 4, 5, to 9 ampules a day was also compared. The output was about the same regardless of the number of ampules.

**Conclusion** The tendency to a decreased urinary output is not sufficient to be of clinical importance, except possibly in patients with an already damaged urinary system in whom it should be used with caution. It is very unlikely that 1, 2, or 3 injections could have under any circumstance any serious sustained effect on urinary output.

#### PITRESSIN IN POSTOPERATIVE ATONY

Pitressin and pituitrin have been used in the treatment and control of postoperative

distention in 3 ways (1) in the treatment of the paralytic ileus of peritonitis, and (2) as a routine measure for the prevention of distention. We have carried out a clinical investigation to study the problem from these 3 angles. In addition to our own observations, a full time technician was assigned for 6 months to make observations and measurements, and to gather data under our direction. The cases investigated were, for the most part, those in which gynecological operations had been performed, since these operations afforded us fairly well standardized operative procedures for comparison.

Following any laparotomy the gut becomes more or less parietic and is distended by gas. The paresis is largely the result of trauma and is more or less directly proportional to the severity and the duration of the trauma, not only to the gut itself but to the abdominal wall and the retroperitoneal structures. Large quantities of blood left in the abdominal cavity increase the atony, but not as certainly as a bit of toxic or infected material. The distention usually lasts 48 hours and efforts to move the bowel within that time are futile. Of necessity, in addition to a paralysis there must be gas or there will be no distention. The gas has 3 sources, first, the bacterial and enzymic fermentation of the contents of the gut, second, the diffusion of gas, chiefly nitrogen from the blood stream into the bowel lumen, and, third, the swallowing of air. Of these 3 the last source accounts for most of the gas. Hibbard and Wangensteen have shown that if intestinal obstruction is produced in a dog which has an esophageal fistula distention is slight, they have calculated that 66 per cent of the gas in the distended bowel is swallowed. Thus it is obvious that if one were to prevent postoperative distention he could do it most perfectly, first, by reducing to a minimum the amount of irritation and trauma in the abdominal cavity and its vicinity, second, by eliminating from the gut tract all material that would produce gas, and, third, by preventing the swallowing of air. To accomplish the first of these is the personal affair of each surgeon in each operation. A relatively empty gut can be obtained by giving the patient a

residue diet for 4 or 5 days, and giving him daily enemas. A cathartic the day before operation is harmful, because it clears out the solid material but leaves in the bowel liquid which is not only more highly infective but is more fermentable. The only efficient method to prevent distention from swallowed air is to insert a nasal catheter with constant gastric siphonage, as advocated by Wangensteen. It is rare that the surgeon feels this is necessary in an ordinary laparotomy, however, in an obese person, for example, with a large postoperative ventral hernia the procedure is well worth while.

When a patient's abdomen is distended 48 hours or more following a laparotomy and he is in distress, there may be 1 of 3 abdominal causes. The distention may be due to postoperative atony, to paralytic ileus as a result of infection within or close to the abdominal cavity, or to mechanical obstruction. At the outset it is not possible to be certain as to which is responsible, most likely in an uncomplicated laparotomy it is the first, and treatment is instituted on the basis of this assumption. There are ordered in succession, a rectal tube, ordinary enema, irritative enema, morphine, and, if necessary, constant gastric suction. Although at this stage the clinician begins to wonder if there is not present something more serious than simple postoperative atony, he at the same time casts about for some more effective means of expelling the gas. That pituitrin or pitressin under these circumstances will relieve distention is by no means a new observation. However, the physician sometimes hesitates to use it for fear of spreading a localized peritonitis or aggravating an intestinal obstruction.

We have made records of the distention immediately following the use of pitressin in 15 patients who 48 hours after operation developed distention, which we were unable to relieve by a rectal tube.

In order to determine the variations in abdominal distention in these and subsequent cases frequent measurements were made of the abdomen. Points of measurement were established by marking with mercurochrome

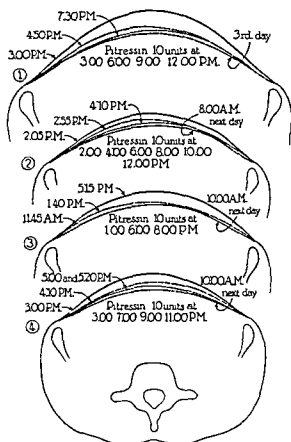


Fig 2 Beneficial effect of pitressin on distention due to atony occurring 48 hours after operation 1 Operation performed to free adhesions causing pyloric obstruction Two days after operation distention was quite marked A rectal tube was ineffective One and one half hours after the first injection of 10 units of pitressin there was a sharp reduction in distention Note that approximately the maximum effect was produced by the first dose and that this measurement is comparable to the measurement made 3 days later when patient's condition was normal A suprapubic hysterectomy and appendectomy Forty-eight hours after operation distention was not relieved by a rectal tube In addition to units of pitressin was given every 2 hours There was an immediate reduction in distention and in discomfort neither of which recurred 3 A pan hysterectomy Distention and discomfort on the third day An injection of 10 units of pitressin was given plus a soap suds enema The size of the abdomen instead of being decreased was increased returning to the original on the following day This is 1 of only 2 patients in this series whose distention was not relieved by pitressin 4 A supra cervical hysterectomy Distention which appeared on the third day was not relieved by a rectal tube but when injection of pitressin in 10 unit doses was begun it was sharply reduced Note again that approximately the maximum effect was produced by the first injection Subsequent injections 5 in number were probably unnecessary

a spot on the skin just above each iliac crest in the midaxillary line A lead tape was then

laid over the abdomen between these points so that its curve would correspond to the abdominal curvature It was removed and the resulting curve traced on a sheet of paper In this way we had but a crude method of determining distention, however, the record obtained proved much more satisfactory than the impression gained from examining the abdomen In this series there were performed 18 pelvic laparotomies, 2 vaginal hysterectomies, 2 recurrent ventral herniotomies, 1 appendectomy, and 1 nephrectomy Repeated measurements were made upon these patients immediately after the injection of pitressin In all but 2 instances there was a definite reduction in the abdominal measurement followed by subjective relief A fairly good composite picture of what happens is shown in Figure 2, 4 In about an hour after the first injection the distention is diminished If a second injection is given there is usually very little further reduction in the measurement The abdomen remains flat on the following day A rectal tube is necessary to obtain good results, and a better result may be obtained if an enema is given about 15 minutes after the pitressin is injected The dosage cannot be standardized We have used for the most part 10 pressor units intramuscularly, 20 units is certainly more effective, but in our experiments on normal individuals we not infrequently found violent contractions associated with severe pain when we used 20 units In small individuals, or when the need is not great, it is probably better to give 10 or 15 units If there is no effect, a second dose of 20 units could be used an hour later If after 2 injections there is no improvement, it is unlikely that pitressin will prove effective in that particular case If a few injections combined with a rectal tube are not effective one can promptly suspect that there is a more serious basis for the distention than mere postoperative atony If there is peritonitis or obstruction will pitressin cause harm? We have used it in peritonitis frequently enough to be of the opinion from clinical observations that it does not spread a peritonitis If only a few injections are used it is very unlikely that harm will result If the bowel is paralyzed by a peritonitis it is even unlikely that there will

To evaluate the effect of any form of therapy upon abdominal distention is a difficult matter. One of us (F. H. F.), operating on gynecological cases only, used ptreassin before and after operation on alternate patients. The untreated patients were used as controls. The ptreassin series consisted of 14 suprapubic operations and 2 vaginal operations, the controls, of 15 suprapubic operations and 1 vaginal operation. One and sometimes 2 ampules of ptreassin were given  $\frac{1}{2}$  hour and just before operation in order to determine the effect on the gut. The intestinal causes relatedly little trouble in gynecological cases and observations on the small intestine are not as easily made as in upper abdominal operations. There was a tendency for the bowel to be more contracted, but the difference, quite definite in some, was more or less conjectural in others. It is probable that there was some contraction in every case, but it was not sufficiently marked so that the operator could determine clinically which patient received ptreassin and which one did not.

Immediately following operation 10 units or 20 units were given every 4 hours for 9 injections. Daily measurements of the abdomen were made to determine the amount of the distention in the 2 series. After any laparotomy the abdomen becomes more or less distended and the amount of measured distention is by no means a criterion as to the amount of distress the patient has. The measurements, on the whole, showed that the ptreassin series had less distention than the control series. A measurement was taken immediately after operation, followed by daily measurements. By measuring the curves we were able to calculate the average number of centimeters the center of the abdomen was distended above or below the first measurement. In the controls, the abdomen became slightly distended until the fourth and fifth day when it flattened out. In the ptreassin series the abdomen never distended. In fact, on the third day the measurement was less than on the first. Although the ptreassin series had a tendency to be less distended, the most marked difference, which occurred on the third day, averaged less than 1 centimeter, which is not enough to be of any significance. The postoperative abdominal

We have not made enough observations on the following point to be absolutely sure, but as a rule it on auscultation of the abdomen no peristaltic sounds are heard if the ptreassin is ineffective. If the abdomen is distended and peristaltic sounds are present it is effective. There can be no denying that such a peristaltic stimulant would be harmful if intestinal obstruction were present. Two patients with postoperative obstruction were given ptreassin every 4 hours. Both of them required a second operation for relief, but in neither case could we observe any marked exaggeration of the symptoms. Since the effect wears off soon, if one does not persist in administering the drug probably little harm will ensue.

*Conclusion* Ptreassin given in 10 or 20 units, combined with a rectal tube is effective in postoperative atony. A few injections probably due to either a peritonitis or to an obstruction. If one does not persist in the use of ptreassin, it is doubtful that any harmful effect can be produced.

#### ROUTINE USE OF PIRESSIN BEFORE AND AFTER OPERATION

There have been several reports on the beneficial effects of ptreassin when used in a routine measure before and following laparotomies. Bidwell gave ptreassin every 4 hours after 21 laparotomies. All the patients passed gas within a few hours after the first injection, and were free from any abdominal pain or distention. Potter (42) has reported favorable results from the routine use of ptreassin in 1,200 cases. He recommends an intramuscular injection of 20 units before operation and then at approximately 4 hour intervals for 2 or more days. He aims to begin the injections when the bowel is not distended and thus never allow it to become distended. When it is given before operation, he has noticed that the small bowels contract down in 15 to 20 minutes, thus making them easier to handle and also making the closure easier (43). Black used it in 60 laparotomies and found a definitely contracted gut which was much easier to handle during the operation and the closure.

discomfort was about equal in the 2 series, as were the number of enemas and the number of injections of morphine that were required. There was no effect in this and other series in alleviating urinary retention.

In another series of 40 relatively uncomplicated operations pitressin was used prophylactically as a routine measure. The dosage varied considerably but averaged 6 to 7 ampuls of both 10 units and 20 units every 4 hours. There were 31 pelvic laparotomies, 4 cesarean sections, 3 tubal pregnancies, 1 pyloric obstruction due to adhesions, 1 gastric resection. In none of these patients was there any marked distention according to measurements. They were operated upon by various surgeons, and observations were made by various individuals. The consensus was that its routine use aided in the control of distention and made the patients more comfortable the effect, though not marked, was beneficial. In the 4 cesarean sections and 3 tubal pregnancies recovery was remarkably uneventful; there was not the slightest distention and very little postoperative discomfort. A few patients had severe cramps following each injection, a few felt nauseated, pallor occurred in nearly every patient who received 20 units and vomiting occurred in 3. Beyond this there were no untoward events that could be attributed to the pitressin.

**Conclusion.** Pitressin given pre-operatively has a tendency to contract the bowel. Its routine use after operation tends to reduce somewhat the amount of distention and discomfort following operation. Neither effect is sufficiently important to make its use in this manner mandatory.

#### PITRESSIN IN PERITONITIS

The postoperative treatment of peritonitis consists largely of the use of parenterally administered fluids, constant gastric siphonage, and morphine. Formerly many surgeons made rather violent attempts to move the bowels and relieve the distention. At present, most surgeons try to promote intestinal quietude in order to allow the infection either to subside or to localize. The marked distention of the gut in peritonitis produces a nutritional impairment of the bowel wall and is a very im-

portant factor in causing death. Attempts to control it completely are unsuccessful. Decompression by constant gastric suction and a rectal tube are the only measures that are of much help. Pituitrin and its active component, pitressin, have been frequently recommended in peritonitis (2, 8, 27, 40, 52). Potter (41) reports its use in 222 cases of acute appendicitis with and without peritonitis with a reduction in mortality rate to 4 per cent. Berry attributes to its routine use a reduction in mortality rate in acute diffuse peritonitis from 35 per cent to 17 per cent. On the other hand, Davis and Owens found pituitrin of little value in cases complicated with peritonitis.

In various wards throughout the hospital pitressin was used for patients who already had a peritonitis. In all of these cases the individual was extremely ill, many times in *extremis*. In this manner it was used persistently, 3 to 5 ampuls daily, in the following 36 cases. There were 16 postoperative gynecological cases with 10 deaths, of these, 7 patients had localized abscesses in the pelvis and only 2 died. There were 2 patients with post-abortion peritonitis, both of whom died. There were 2 patients with ruptured duodenal ulcers, 1 died a week after operation apparently from a localized abscess, the other died in 8 days of delirium tremens, and at autopsy there was no evidence of peritonitis. Two patients with peritonitis of unknown cause and 1 with a thrombophlebitis did not recover. Three patients operated upon for appendicitis recovered: 1 had a localized abscess in the right lower quadrant. Two patients who underwent gall bladder operations recovered: 1 had an abscess of the gall bladder, the other a bile peritonitis. Although these last 5 cases had intraperitoneal infection over a considerable area one cannot say that it was generalized. Nine patients who were operated upon for hypertrophied prostate developed marked distention, in what part due to general or local peritonitis or uremia it is hard to determine. In some of them the distention was improved, but only 1 recovered. The entire group consists of 36 cases with 12 recoveries. Those who obviously had a severe spreading peritonitis number 18 with 1 recovery. In spite of

From a study of the measurement of the administration of fluids, and morphological gastric siphonage, continuous intravenous better not worse. All of them had constant stress, but that the others were made neither probably been made worse by the use of pi observation it was felt that i patient had this tremendous mortality rate, from clinical

From a study of the measurement of the abdomen it becomes clear at once that pitting is not very effective in reducing distention of the bowel caused by either a local or general peritonitis. Figure 3, showing the measurements following its use in peritonitis, is much different from that following simple postoperative atony. As a rule there is no relief of the distention, and if there is improvement it is

does not persist. True, at times 20 units of pitressin plus an enema causes the expulsion of large quantities of gas with some subjective relief. Vogt and Kliner, Pitzasek, and Scheps recommend its intravenous use. Vogt used intravenous injections with constant intravenous administration of deoxycose and saline in 81 cases of postoperative ileus with 75 recoveries. He invariably obtained expulsion of the intestinal contents along with rather sharp vasomotor reactions. It seems to us that intravenous injection is too drastic treatment. *Conclusion* Possibly the stirring up of in-

testinal activity by ptyressin is harmful, possibly it is not harmful. From our experience we cannot say, but we do believe that a patient with peritonitis will recover or die regardless of whether he does or does not receive ptyressin.

SUMMARY

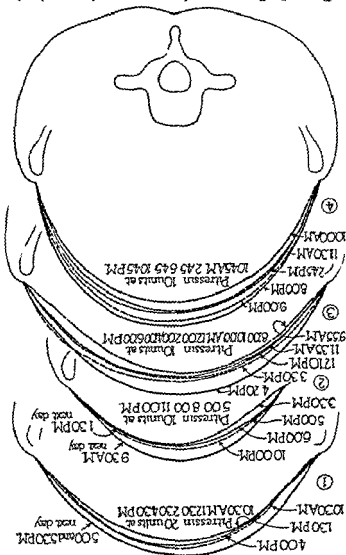
By insufflating a normal individual's colon it is definitely shown that pressure produces powerful colon contractions

with a rectal tube quickly flattens out the abdomen in simple postoperative atony. Twenty units is an ample dose, and at times it is too much.

3 The secondary effects of pitressin on the vascular and urinary systems are relatively unimportant in ordinary therapeutic doses but they should be kept in mind

4 The routine use of pitressin before and after laparotomies was not notably beneficial in a series of well controlled cases

Fig 3. Ineffectiveness of paresthesia in relieving the discomfort of peritonitis. A 30-year-old woman developed a generalized peritonitis following a parathyrectomy. Six days after operation 4 doses of 10 unit amount of streptomycin were given every 2 hours. One hour after the second dose the patient was returned to his ordinary size. The following day the abdomen was distended more than ever. The patient died 19 days after operation. A general peritonitis appeared 2 days after distillation and cholecystitis. After 13 days the patient's condition was very grave. In spite of 3 injections of 10 units of penicillin, the distension increased. On the following day it was more markedly increased. A second series of 3 injections produced a very temporary reduction. This patient died 17 days after the onset of peritonitis. A severe peritonitis was present 3 days following a parathyrectomy. Every 2 hours 20 ampuls of penicillin in 10 unit doses were given. The abdomen steadily increased in size. The next day a 1-2° coma was quite effective in reducing the distension but it rapidly recurred. This patient died 5 days after operation. A 40-year-old male patient had a parathyrectomy. The abdominal measurement continuously increased every 4 hours. The abdominal measurement of 100 cm was begun and given 10 unit doses of penicillin in 10 unit doses was begun and given every 2 hours. The next day distension and an irritative enema milk and molasses were of benefit in relieving the distension but not in improving the patient's general condition. Death occurred 9 days after operation.



5 Its administration after the onset of peritonitis did not influence the outcome for better or for worse

NOTE.—Acknowledgment must be made here of faithful recording of observations by the graduate nurse, Core Osterholm, without which this report would have been impossible. The experimental work has been supported by a grant from Parke Davis & Co.

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# THE PHENOMENON OF LIGHTENING IN PREGNANCY AND THE LOWER UTERINE SEGMENT

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**O**BSERVATIONS made on the condition of the lower uterine segment during the performance of cesarean section and a consideration of the mechanism of the engagement of the presenting part have caused an investigation into the formation of the lower uterine segment and its clinical significance. During the performance of cesarean section the vertical length of the lower uterine segment observed before and after the onset of labor, and the station of the presenting part have been so variable that the problem is, how is the lower uterine segment related to the phenomenon of lightening? When does it manifest itself clinically and what is its clinical importance? I believe that the phenomenon of "lightening" is primarily due to the final physiological phase in the preparation of the lower uterine segment for parturition. Physiologically and clinically the early formation of the lower uterine segment is manifested by the Hegar's sign of pregnancy. The descent of the presenting part into the pelvic cavity is a passive process due to the active relaxation of the lower uterine segment and is clinically known as the phenomenon of lightening.

The purpose of this paper is to analyze the phenomenon of lightening and to consider all the possible causative factors that may be concerned and to offer new explanations based upon anatomical, physiological, and clinical grounds.

A brief review of the literature will suffice to indicate the current views relating to the cause of the phenomenon of lightening. DeLee writes that the uterus sinks gradually downward and forward. This leads to a gradual sinking of the fetal head into the true pelvis. The formation of the lower uterine segment may be a part of the process. Edgar, Eden and Holland, Peterson, Shears and Galabin

and Blacker ascribe lightening to the descent of the uterus with the presenting part into the true pelvis. Edgar further suggests that descent is due to the gradual relaxation of the soft parts. Webster states "It is often noticed that during the last month of pregnancy the fundus sinks somewhat. In primiparæ this is generally due to the sinking of the uterus vertically as a whole (clinically this is described as a sinking of the fetal head within the true pelvis). The reason for the sinking of the uterus as a whole in primiparæ is the strength and resistance of the abdominal wall, as the uterus increases, it is forced in the direction of least resistance, i.e., downward." Solomons states "Lightening is probably due to the dilatation of the lower uterine segment, providing new space for the liquor amni, with consequent descent of the fundus, and at this time the head usually passes into the pelvis."

The chief features of the phenomenon of lightening are a descent of the presenting part into the true pelvis and an exaggeration of the anterior tilting of the uterus when the patient assumes a standing posture, which gives subjective relief from the symptoms of intra-abdominal tension.

The possible mechanisms concerned in the phenomenon of lightening which are discussed in the literature and which occur to the author, are (a) the formation of the lower uterine segment (b) the relaxation of the soft parts of the pelvis (c) the great mobility of the posterior uterine attachments, (d) the adaptive relaxation of the muscles of the abdominal wall analogous to that which occurs on the ingestion of a meal, and (e) the cephalopelvic relation.

## THE CAUSE OF THE DESCENT OF THE PRESENTING PART

During the last month of pregnancy and usually concomitant with the phenomenon

of lightening, the presenting part descends into the pelvic cavity. The problem is to determine whether the descent is due to (a) relaxation of the lower uterine segment, or (b) a pushing downward of the uterus caused by a relaxation of the pelvic floor and the uterus and uteropelvic ligaments, or both.

#### FORMATION OF LOWER UTERINE SEGMENT

In regard to the rôle played by the lower uterine segment in the phenomenon of lightening, two questions immediately arise, namely: at what time does the lower uterine segment become recognizable anatomically and clinically, and does it definitely relax more or less abruptly and concomitantly with the phenomenon of lightening?

When does the lower uterine segment become recognizable anatomically? A study of frozen sections demonstrates that the lower uterine segment becomes progressively more and more evident from the second month of pregnancy to term. Von Franque has studied 177 frozen sections, 34 uteri of his series and the balance from the literature, and found that the lower uterine segment was present in uteri from the second to the tenth month of pregnancy. The lower uterine segment measured vertically as follows: second to fourth month, 2.3 centimeters, fifth to sixth month, 4.1 centimeters, seventh to tenth month, 6 centimeters, and during labor it varied from 3 to 10 centimeters in all gravid uteri irrespective of the month of gestation. Benckiser found, on studying frozen sections, that the lower uterine segment is present in 4 month pregnancies Webster in a fifth month frozen section found a well differentiated upper and lower uterine segment. Bayer, Leopold, and Hommer found the lower uterine segment in frozen sections from the third month to term. Vossat-Sison reported that the lower uterine segment begins to appear soon after implantation. Thus, anatomically, the lower uterine segment may be recognized soon after implantation and may be considered as present clinically when the Hegar's sign can be elicited. To ascertain how well the data from frozen sections check with the living anatomy, measurements of the vertical width of the lower uterine segment were made during the performance of the low cervical cesarean section at or near term. When cesarean section is performed before the onset of labor, one cannot usually observe by inspection and palpation the junction of the two uterine segments. But, after the child has been delivered and the upper uterine segment has undergone retraction, it is frequently found that the hysterotomy incision may extend some 2 or 3 centimeters into the upper uterine segment. However, if the section is performed after several hours of labor and if retraction of the upper uterine segment and cervical dilatation have occurred, the physiological retraction ring or the junction between the two uterine segments can usually be determined accurately. When the distance from the uterovesical reflection of the peritoneum to the physiological retraction ring or to the fixed anterior uterine peritoneum is measured before or after the onset of labor, it is found to be from 6 to 14 centimeters (38 cases). The distance tended to be greater after labor had begun. These measurements check rather well with those from frozen sections. Does relaxation of the lower uterine segment account for the descent and for part of the phenomenon of lightening? That Hegar's sign represents clinically the initial stage of the formation of the lower uterine segment is generally accepted (6, 9, 10, 22, 31, 32). This should be anticipated because after the implantation of the ovum the muscle fibers of those portions of the uterus which are later to form the upper and the lower uterine segments undergo hypertrophy and some hyperplasia. The growing ovum of the first 6 weeks of gestation normally occupies the uterine cavity above the physiological retraction ring or the anatomical internal os of Aschoff (2). At about the seventh week of gestation, the beginning of the fetal stage (embryos between 1.5 and 16 millimeters), some dilatation of the anatomical internal os and vertical lengthening of the isthmus uteri occur. This progressive change continues so that by the end of the first trimester, the uterus is a globular organ with the fetus occupying the upper and sections check with the living anatomy, meas-

the lower uterine segments. Thus, we believe that the anatomical internal os by dilating and ascending reasonably, and possibly on the basis of a study of frozen sections and comparative anatomy and physiology (24, 25), becomes the retraction ring of Barbour and Lusk or the contraction ring of Schroeder, or preferably the physiological retraction ring (23).

At the end of the thirty-sixth week or there about the lower uterine segment may be physiologically differentiated, so that in response to an increase in intra uterine pressure or some other stimuli, it may manifest its normal response of relaxation to accommodate the growing ovoid or the adjustment of the fetal posture for its coming part in the mechanism of labor, thus, leading to some descent of the presenting part but to no retraction or thickening of the upper uterine segment. Interpreted in this manner the phenomenon of lightening should be a favorable clinical sign in indicating that the lower uterine segment is ready to perform its function.

If the descent and a portion of the phenomenon of lightening are due to relaxation of the lower uterine segment, this should be borne out by observing the cervix to be more flattened out against the presenting part and by a decrease in the distance between the cervix and the fundus uteri in the prone position. There is ample evidence in the literature showing that both occur after the phenomenon of lightening.

Yet the phenomenon of lightening may occur without a decrease in the height of the fundus uteri regardless of whether the presenting part is in the pelvis in normal cephalopelvic relation. The author has found the MacDonald measurement to be about 32 centimeters at the thirty-sixth week of pregnancy and about 33 centimeters at term whether the presenting part is high or low in the pelvic cavity. This has been observed by others (15, 19, 28). In 2 other patients the MacDonald measurement was 26 centimeters at term, 1 was delivered of a small child weighing 6½ pounds, and the other of a child with an encephalocele. When the MacDonald measurement was greater than 35 centimeters the cause was either a frank breech (either high or floating), hydramnios, twin pregnancy, mon-

strosity, cephalopelvic disproportion, pelvic neoplasms, or obviously "absence of the phenomenon of lightening." Such observations complicate the explanation of the phenomenon of lightening. If the presenting part is high, the phenomenon of lightening must have been due to relaxation of the abdominal muscles (*vide infra*). If the head is low, and the phenomenon of lightening has been experienced, but the fundus is high, there must be either an increased amount of amniotic fluid or the fetus must be more extended than normally due to contraction or shortening of the circular muscle fibers of the uterus, giving the uterus a more cylindrical form. Of course, if the position of the presenting part varies considerably between the prone and upright positions and the cervix is flattened out, this would indicate considerable softening or relaxation of the pelvic supports.

*Relaxation of the soft parts of the pelvis.* Obviously a relaxation of the pelvic soft parts may account for descent or at least a portion of it. In this connection the hormone *relaxin* (17) which is produced by the corpus luteum and plays such an important role in parturition in the guinea pig by softening the pelvic ligaments (separation of the pelvic bones), comes to mind. However, relaxin has not been found in the blood of pregnant women, although entirely adequate methods to determine its presence have not yet been employed. Yet if the cervix descends concomitantly with the occurrence of lightening, this may contribute to the cause of the phenomenon.

Clinically it is known that when Hegar's sign becomes manifest the cervix is usually located somewhat higher than normally, but later descends to its original position. In unusual instances it may later descend so much that folding of the vagina occurs (9). Since it has not been shown that the fibrous ligaments actually soften in women, it may be postulated that the muscle fibers of the fibromuscular (uterosacral and uteropelvic) ligaments may be reflexly relaxed, possibly permitting some descent. In many parturients the cervix does not descend appreciably or significantly, and lightening must then be due to other factors. Yet, if the cephalopelvic relation is normal, the fetal head can be easily impressed



anterior uterine wall is about 6 millimeters thicker than the posterior uterine wall, so the greater retraction of the anterior uterine wall, and the pulling upward and outward of the posterior uterine wall bring the posterior uterine wall from the fundus to the physiological retraction ring to measure 16 25 centimeters. A consideration of the difference in the physiological changes of the anterior and posterior uterine walls demonstrates the equalizing phenomenon of the 10 centimeters difference in order to form the uterovaginal wall for the second stage of labor. This demonstrates the purposefulness of equalizing the physiology of the uterus in bringing about the harmonious function of the uterus in antelexion and dilation of the cervix uteri.

These measurements of Barbour and Webster demonstrate beautifully the compensatory changes which occur in different portions of the uterus and the birth canal and that retraction is a remarkable phenomenon that is essential for the equalization of cervical dilation. The natural tendency toward anterior tilting is still maintained even during the second stage of labor.

However the fact that in a pendulous abdomen the uterus falls forward quite markedly when the standing posture is assumed shows that the posterior supporting structures and the 'retractile tone' of the posterior uterine musculature are not sufficient to maintain the gravid uterus of the ninth month or even before, in a semi-erect posture. Hence, it follows that the tone of the muscles of the anterior abdominal wall play the most important role in determining the degree of the anteversion in lightening. This, of course, is the conclusion of most obstetricians, but none have attempted a physiological explanation for the rather abrupt change (24 to 48 hours) in the tone of the abdominal muscles that is frequently observed.

#### THE ADAPTIVE RELAXATION OF THE MUSCLES OF THE ABDOMINAL WALL

The sudden decrease in tone of the muscles of the lower abdomen in lightening suggests to a physiologist that a reflex mechanism may be concerned and that a sudden change in the 'level' of a reflex tonus mechanism has oc-

curred. Such a change may also occur gradually. In this connection it is known that when a meal is ingested, not only does the stomach relax to receive the swallowed food, but the abdominal muscles also relax reflexly to prevent an increase in intra abdominal pressure (7). It is highly probable that a similar relaxation of the abdominal muscles occurs during pregnancy. Coombs has made a study of pregnant cats. She found that in pregnancy there is a greater ability of the abdomen to accommodate more fluid at a low pressure than in the non pregnant cat, and concluded 'We must acknowledge the intervention of a reflex nervous regulatory mechanism.' The exact reflex pathway that may be concerned in such relaxation has not been determined, but Coombs' observations show that the nature of the mechanism is reflex. Because sensory fibers in the vagi or splanchnic nerves are most probably responsible for the relaxation of the abdominal muscles that occurs when a meal is ingested (7), it is possible that sensory impulses from the uterus or pelvic soft parts (via the pelvic nerves or the lumbar sympathetics) are concerned in the production of the relaxation of the abdominal muscles in pregnancy. One cannot disregard the possibility that some of the relaxation may be due to the segmental reflex arcs that innervate the abdominal musculature i.e. the stretch of the abdominal muscles stimulates the sensory nerve endings which maintain the tone of the muscle at different levels, and, at the ninth lunar month, the sensory impulses set the spinal center at a lower tonus level. This would be difficult to determine experimentally, however. That the segmental arcs are set at a lower tonus level is shown by the observations of Coombs, we are ignorant only of the mechanism. The explanatory hypothesis that appeals most to the author is that the lower uterine segment relaxes permitting the presenting part to descend and that sensory impulses set up by the relaxation of the lower uterine segment, or by the pressure of the presenting part on the pelvic soft parts, the latter being much more likely (*vide infra*), induce reflexly a relaxation or change in the tone of the abdominal muscles. A less likely hypothesis, when one con-

measurement shows no change before and after lightening. I have demonstrated that the vertical increase in size of the lower uterine segment is a gradual one from midation of fertilized ovum to term, frequently the lengthening is rapid in the last month of pregnancy. Therefore, this vertical lengthening is an active process of the lower portion of the uterus. A study of living pathology observed during the performance of cesarean section demonstrates the variable vertical lengths of the lower uterine segment and checks rather well with the knowledge gained from a study of frozen sections.

The clinical phenomenon of lightening is explained on the basis of the passive descent of the fetal head into the pelvic cavity by either an acute or gradual active vertical elongation of the lower uterine segment usually during the last month of pregnancy, the downward and forward drooping of the uterus is due to a relaxation of the abdominal muscles with no change in the MacDonald measurement which is due to the increased vertical length of the lower uterine segment, but no corresponding change in the upper uterine segment, and the increase in the epigastric space resulting in more comfort for the patient is due not to a descent of the uterus as a whole, but to the increased antelevation of the uterus brought about by the relaxation of the abdominal muscles which causes an increase in the intra-abdominal space, and the fundus of the uterus only passing downward and forward brings about an increase in the epigastric space.

The clinical value of understanding the phenomenon of lightening will be briefly stated as follows.

In normal cephalopelvic relation the presenting part may be floating or high on account of the temporary delay in the phenomenon of lightening, which may occur during the last month of pregnancy, the first stage, or occasionally in the second stage of labor. The differential diagnosis of a functional or mechanical floating or high fetal head is determined by the impression method.

In cephalopelvic disproportion lightening may have taken place, but the mechanical factor is the cause of the floating or high fetal

siders certain abnormalities (*vide infra*), is that when a certain abdominal pressure is are stimulated and reflexly cause a relaxation of the muscles of the pelvic floor and the fibromuscular ligaments, a relaxation of the lower uterine segments, and a reduction of the tone of the muscles of the lower abdomen.

## DISCUSSION

The consideration of the sequential changes of the pregnant uterus demonstrates the possibility of the vertical changes of the lower uterine segment and its anal preparatory phase for parturition.

The mechanophysiological requirement of the pregnant uterus for its function of expulsion of the ovum as shown from the study of frozen sections is that the lower uterine segment is gradually increased in its vertical length. The anatomical fixation of the anterior portion of the cervix uteri to the pubic segment of the pelvis demonstrates the pivot of uterine mobility and the equalization of cervical dilatation by the difference in the retraction of the anterior and posterior uterine walls as established from a study of frozen sections of the second stage of labor, and particularly the measurements of the second stage frozen section of Barbour and Webster (*vide supra*). Comparative anatomy and physiology points to the homologous mechanism of the uterus is, therefore, based on anatomical and physiological considerations as to the normal position of the pregnant uterus. The exaggeration of the antversion of the uterus after lightening, in either an acute or gradual manner, appears to be a logical explanation based on a reflex mechanism in causing the relaxation of the abdominal wall which is suggestive from the studies of Cannon and Combs.

The clinical evaluation of the phenomenon of lightening can be readily correlated to the physiology involved. A normal cephalopelvic relation is the basis of the phenomenon of lightening. When it has occurred the fetal head is in the pelvic cavity, and the epigastric space is increased in size. The MacDonald downward and forward, and the epigastric head is in the pelvic cavity, the uterus is more lightening. The basis of the phenomenon of lightening involved. A normal cephalopelvic relation is the basis of the phenomenon of lightening can be readily correlated to the clinical evaluation of the phenomenon.

head, yet the sign of the fundus uteri being downward and forward is present

In distention of the uterus due to polyhydramnios and twin pregnancies, the phenomenon of lightening may have taken place, but on account of the tension of the lower pole of the uterus, which rests on the pelvic inlet, the presenting part and the cervix uteri are found to be high

In placenta previa, the progressive change of the lower uterine segment explains the painless causeless uterine hemorrhage that may occur at any stage of pregnancy from the formation of the placenta (third to fourth month) when it is unavoidably separated from the lower uterine segment. In this connection we may reasonably assign some cases of abortion occurring between the third and fourth month of pregnancy as being due to placenta previa

#### SUMMARY

The lower uterine segment is mainly demonstrated clinically by Hegar's sign of pregnancy, the phenomenon of lightening and the engagement of the presenting part which takes place during the last month of pregnancy are acute manifestations of the final physiological phase of the preparation of the uterus for parturition. The phenomenon of lightening, therefore, consists of (a) the final physiological phase of the formation of the lower uterine segment, (b) the passive descent of the presenting part into the pelvic cavity, and (c) the pressure of the presenting part or the final physiological phase of the relaxation of the lower uterine segment, which excites a reflex nervous mechanism that is responsible for the more or less abrupt relaxation of the abdominal muscles which is the cause of the exaggerated anteversion of the uterus that occurs on assuming the standing posture. In those cases in which the phenomenon of lightening occurs gradually, the descent of the presenting part into the pelvic cavity and the reflex mechanism respond progressively and not abruptly. Apparently in all conditions which prevent a descent of the presenting part into the pelvic cavity the phenomenon of lightening does not result or is not strikingly evident

#### CONCLUSIONS

- 1 The phenomenon of lightening is related to the formation of the lower uterine segment
- 2 The lower uterine segment is clinically recognized early by Hegar's sign of pregnancy
- 3 Normally, the lower uterine segment progressively elongates vertically from the sixth week of pregnancy to term
- 4 The phenomenon of lightening which occurs in the last month of pregnancy is due to the final physiological phase in the formation of the lower uterine segment which passively allows the presenting part to descend into the pelvic cavity when the cephalopelvic relation is normal
- 5 The falling forward and downward of the fundus uteri is due in part to a reflex relaxation of the abdominal muscles
- 6 The lower uterine segment may be delayed in its final physiological phase to some time near the onset of labor, in the first stage, and occasionally in the second stage of labor
- 7 The delay in the phenomenon of lightening explains the mechanism of hemorrhage in placenta previa occurring after the first trimester, or at any stage of pregnancy and labor
- 8 Delay in the final physiological phase of the formation of the lower uterine segment is the differential diagnostic criterion between a functional and mechanical dystocia when the presenting part is high or floating
- 9 Abortions and premature labors may be caused by an early phenomenon of lightening

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# CLINICAL SURGERY

FROM THE UROLOGICAL SERVICE OF THE BROOKLYN HOSPITAL

## PRIMARY BLADDER TUMORS IN INFANT AND YOUNG CHILDREN

With Report of a Case of Hemangioma in a Male Child 27 Months of Age

N P RATHBUN M.D., F.A.C.S., Brooklyn New York

**B**LADDER tumors in infancy are among the rarest forms of pathological lesions noted in the urinary tract. Beer and Hyman state, "Tumors of the bladder in childhood are so rare that an extensive discussion of their symptomatology and treatment is scarcely necessary."

In some 500 personal observations, no tumor of the bladder was encountered in childhood. Deming, writing in 1924, made a very careful review of the literature and could find only 64 authentic case reports of bladder tumors occurring in the first decade of life, to which he has added 2 cases of his own. In this group only 18 patients were at the age of 2 years or under.

It is perhaps reasonable to assume that other cases have been noted and have not been reported and I have no doubt that, with better diagnostic facilities, including cystoscopes especially devised for infants, they will be recognized with greater frequency in the future. For the bibliography prior to 1924 and for complete data on the cases collected and reported by Deming the reader is referred to his original paper, as only a brief summary is herewith presented. Most of this group consisted of solitary case reports; very few writers having been able to report more than 1 case.

The pathological conditions which were found to be present in these cases are given in the following table:

TABLE I

	Cases
Sarcoma	37
Myxoma	16
Fibroma	5
Rhabdomyoma	2
Polyps (benign)	2
Dermoid	1
Papilloma	1
Myoma	1
Undetermined pathology	1

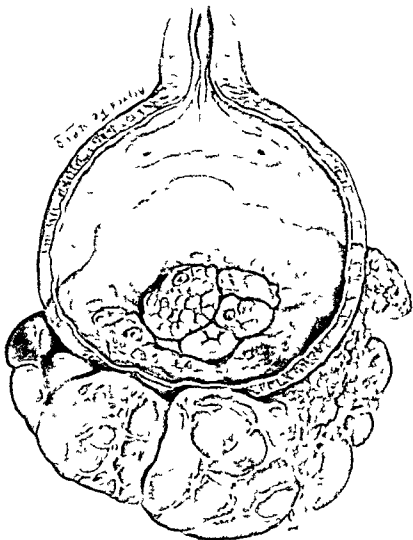
The last case is one reported by Judd from the Mayo Clinic. Dr. William F. Braasch very kindly looked up the records for me and found that the patient was a female child of 7½ years who had had bleeding from the bowel and bladder at intervals for several years. She was admitted to the hospital in *extremis*, died from uremia and at autopsy there was found an hemangioma involving the rectum, sigmoid, and bladder. This case and my own, about to be reported, are, so far as I have been able to determine, the only cases of hemangioma of the bladder in infancy which are reported in the literature. Inasmuch as there might be some doubt as to the original site of the tumor in Judd's case, my own case is perhaps unique.

Of the cases in Deming's group, all but 6 (9 per cent) patients died either of their disease with or without having undergone operation, or the tumor was disclosed at autopsy as an incidental finding. Of the 6 cases reported as cured by surgery there were 2 polyps, 1 fibroma, 1 fibromyoma, 1 polypoid sarcoma and 1 fibrosarcoma. The mortality of the cases with operation was nearly 90 per cent. Concetti reported 9 cases in which patients were operated upon, with a mortality of 100 per cent. The 2 personal cases reported by Deming were (1) a myxoma in a child of 20 months who was subjected to cystotomy, diathermy, and radium, followed by recurrence and death; (2) a rhabdomyoma in a child of 21 months subjected to cystotomy, curettage and cautery followed in a few months by recurrence, reoperation and death.

The male sex predominates 2 to 1, which is somewhat less than the 5 to 1 ratio usually noted in adults.

The principal symptoms noted were hematuria, pain and disturbances of urination. The hematuria was occasionally massive in type, more

Fig. 8 Artist's conception of the tumor as it existed *in situ* made from specimen removed and description of operative findings—semi diagrammatic. The highly shaded portion is an effort to represent the tumor as it hung down behind the bladder wall.



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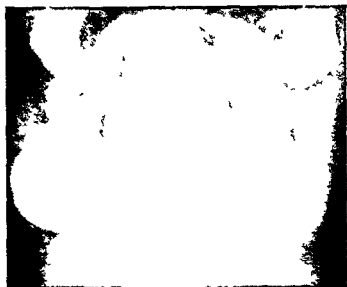


Fig. 1. Cystoscopy obtained as part of subsequent examination. Note slight irregularity of upper border of bladder shadow. Suggestion of tumor defect on the left.

was admitted to the hospital with the chief complaint of dysuria. A mass about the size of a large orange could be palpated over the pubis, bloody urine was passing in occasional dribbles. A right nephrostomy was done for drainage and the child died 1 week later in uraemic coma. At autopsy there was found in extensive involvement of the bladder.

Lazarus and Rosenthal, in 1927, report the case of a male child of 2 years whose complaint was that of hematuria. Cystoscopy showed the polypoid masses on the right lateral wall of the bladder. These were fulgurated cystoscopically with apparent improvement. Four months later there was a recurrence which was again fulgurated, followed by rapid recurrence, cystoscopy, and diathermy, radium, and Colley's toxins were all used, but death occurred 6 months after the operation was performed. The pathological report was myxosarcoma.

Koss, in 1924, reports the case of a male child of 7 years who suffered from von Recklinghausen's disease. On several occasions he had a mild hematuria. He contracted septicemia, with a complicating bronchopneumonia, which caused his death. At autopsy there was discovered a neurofibromatosis of the bladder. Of course, this was not primary and perhaps this case should not be included.

Harty and Lemm, in 1934, report the case of a female child 1 month of age who was admitted to the hospital in extremis with 1 mass in the lower abdomen extending halfway to the umbilicus. Autopsy disclosed a primary neurogenic sarcoma of the bladder.

Sarcoma	1
Myxoma	1
Myxosarcoma	4
Neuroblastoma	1
Neurofibromatosis	2
Fibroma	1
Fibrosarcoma	1
Rhabdomyosarcoma	2
Papilloma	1
Hemangioma	2

TABLE II

frequently terminal, the pain was often associated with irritation in the form of a terminal cystitis, frequency, dysuria, and bed wetting were often noted. The diagnosis was most frequently made on the symptoms plus a palpable mass detected by abdominal or recto-abdominal palpation. In only a few cases was the diagnosis assisted or confirmed by cystography and cystoscopy. This latter item is accounted for by the fact that many of the cases were reported before the day when practical cystoscopes for use in small children were available.

Since Deming's report I have been able to find 8 other cases in the literature these with my case make a total of 75 cases reported to date.

A Montenegro, writing in 1929, reports the case of a male child of 3 years with myxosarcoma of the bladder. He performed a cautious excision with rapid recurrence and death.

Again in 1929, E. Grynfeltt reports the case of a child of 9 months who was admitted to the hospital with a grossly overdistended bladder and a history of bleeding. A cystostomy was performed and the bladder was found to be nearly filled with a tumor mass. Nothing was done other than to place a tube in the bladder, and the child died in 2 months. The pathological report was myxosarcoma.

E. Ross Mintz, in 1931, reports a "round and spindle cell sarcoma, rapidly growing" in a male child of 5 years. He was subjected to cystostomy, diathermy, and radium. There was a rapid recurrence with death 1 year after operation.

E. W. White, in 1931, reports the case of a female child aged 7 years who complained of frequency and hematuria of 7 weeks' duration. At cystoscopy a small mushroom shaped growth was noted near the left ureteral orifice. A cystostomy was performed, the growth was clamped at the base and removed, and the case was fulgurated. The pathological report was neurofibromatosis. The child made a good recovery.

A. G. Weiss and Raymond Meyer, in 1932, report the case of a male child of 4½ years who

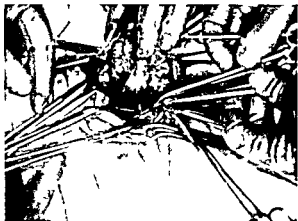


Fig 2

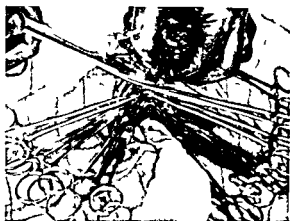


Fig 3



Fig 4



Fig 5



Fig 6

Adding the cases herewith cited and my own case, about to be reported to Deming's list, the pathological process noted in all cases thus far reported appears in Table II

Fig 2 This shows rather clearly the bladder and tumor as they appeared *in situ* at the time of the operation. The wound in the peritoneum is being closed. (This figure together with Figures 3, 4, and 5 was enlarged from a moving picture film of the operation.)

Fig 3 Tumor and part of the bladder are about to be removed. The remainder of the bladder is seen in the depths of the wound held up by artery clamps.

Fig 4 Appearance of tumor immediately after operation.

Fig 5 Closure with appropriate drainage and tension sutures.

Fig 6 X-ray of tumor after its removal showing the small calcareous nodules. On reviewing the cystogram these were noted in the hollow of the sacrum above the bladder shadow. They had been missed at the first examination.

Sarcomas and myxomas were by far the most frequent types of tumor that were noted and they were also found to be the most intensely malignant.

Following is a somewhat detailed report of my own case.

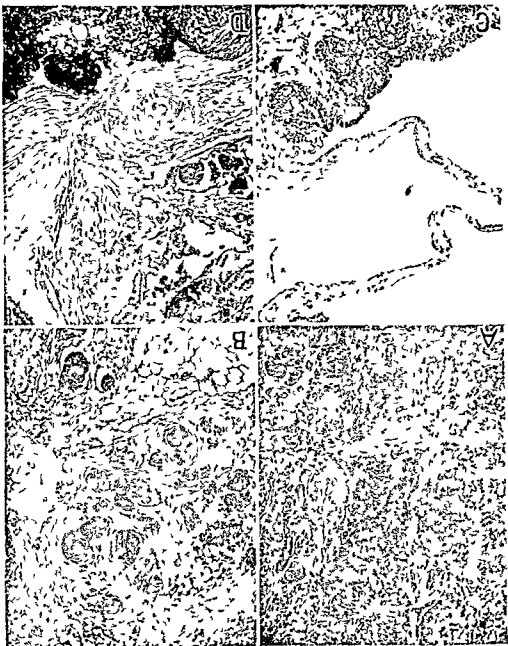


Fig 7 Photomicrographs from various portions of the tumor A, Well formed, blood filled vascular channels with rather thick connective tissue septa B, Some adipose tissue from the outer surface of the growth, containing groups of angiomatous spaces C Bladder mucosa on the inner surface of the tumor In the upper portion of the field is a thin walled cyst D One of the denser areas composed of hyalinized connective tissue Along the lower border of the field the tissue is calcified

The patient was a male child of 27 months who was admitted to the Urological Service of the Brooklyn Hospital on October 26 1936 His chief complaint was hematuria which had existed almost without intermission for the past year The general history was negative except for a mild attack of whooping cough at the age of 3 months When the child was about 1 year old, the parents noted that on occasions he passed bloody urine, they also noted that the urine at the beginning of urination was clear then became darker and that the last drops were very bloody and apparently associated with considerable pain which caused the child to double up and cry At this time he was taken to another hospital where circumcision was advised and performed There was, of course no improvement following the operation and the trouble continued with only occasional intermissions of a few days During this period he had taken various remedies prescribed by the family doctor In spite of this prolonged bleeding, he appeared on admission like a fairly healthy child, whose size and weight were normal for his age The general physical examination was negative except that a soft indefinite mass could be rather vaguely palpated in the hypogastrum The laboratory findings were as follows urine, innumerable blood cells no pus, and no casts Blood examination revealed hemoglobin, 55, red blood cells, 4,450,000, white blood

cells 18 400, polymorphonuclear leucocytes 73 per cent bleeding time  $1\frac{1}{2}$  minutes, clotting time 6 minutes grouping IV. The tuberculin test was negative.

On October 29, 1936 under general anesthesia a cystoscopy was attempted but was unsuccessful because even for his age he had a very small urethra which would not admit a No. 14 French double catheterizing cystoscope which was the only child's cystoscope immediately available. Recto abdominal examination at this time showed clearly a mass in the lower abdomen which appeared to be about the size of a large lemon and was fairly mobile.

On October 30, 1936 he was given a clisis consisting of 50 cubic centimeters of skiodan in 150 cubic centimeters of saline solution and roentgenograms were made at intervals of 30, 45, 60 and 90 minutes. The kidney pelvis were faintly outlined at 30 minutes and were better outlined at 1 hour. The upper urinary tract appeared normal except for a very slight dilatation of the left kidney pelvis. The cystogram (Fig. 1) was very clear. It showed a slight irregularity of the upper margin of the bladder shadow with a suggestion of a filling defect on the left lateral wall.

On November 5, 1936 again under general anesthesia another cystoscopy was undertaken. On this occasion a No. 9 French child's cystoscope was readily passed into the bladder and a rather extensive solid appearing tumor mass was noted which appeared to occupy the dome and upper portion of the posterior wall of the bladder.

On November 9, 1936 he was given a direct transfusion of 250 cubic centimeters of blood.

Operation was performed on November 10, 1936 under ether anesthesia by the open mark and drop method. An incision was made from the symphysis to the umbilicus. This immediately exposed the tumor mass which appeared to arise by a broad base from the dome of the bladder and to extend upward. The urachus was identified tied and cut. The peritoneum was deliberately opened. Through this opening the tumor could be readily palpated extending down behind the bladder but it had not invaded the peritoneal cavity. The peritoneum was stripped off the tumor and bladder and the opening was closed. It was then fairly easy to mobilize the tumor and upper portion of the bladder. They were delivered out of the wound and amputated the incision being carried well wide of the growth. This involved removing rather more than one third of the bladder. This however left a fairly sizable bladder which was closed around a small mushroom shaped catheter. One cigarette drain was placed behind and another in front of the bladder and the wound was closed around the drains.

Figures 2, 3 and 4 illustrate the various stages of the operation and show also the appearance of the tumor *in situ*. The operation required an hour. The patient appeared in good condition but he was given another small transfusion of 120 cubic centimeters of blood.

The tumor when sectioned immediately after removal appeared fairly solid and there were scattered through it a number of very small bony hard masses at first we thought that these masses were bone and that we were dealing with a dermoid. They are clearly visible in a roentgenogram (Fig. 6) made of the tumor.

The child made an uncomplicated recovery. The supra-pubic tube was removed on the ninth day. Two days later he was voiding all of his urine via the natural channels and he was discharged 3 weeks after operation with the wound entirely healed.

The pathological examination of the specimen removed was made by Dr. J. Arnold DeVeer and his report follows.

Gross. The specimen consists of the fundal portion of the bladder, the seat of a multilobulated cystic tumor

The entire specimen weighs 90 grams. The tumor extends through the entire thickness of the bladder wall presenting intravesicular and extravascular portions. The mucosal surface of the growth is reddish brown and finely nodular resembling somewhat the papillated surface of the base of the tongue. Several deep fissures subdivide this tissue into irregularly shaped islands or lobules. Most of the small nodules are semi translucent and of firm consistency, while others are thin walled, bright red blebs filled with serosanguineous fluid.

The bulk of the growth lies like a cap over the outer surface of the bladder wall. It measures approximately 7 by 6 by 4 centimeters in major diameters. It is made up of coarse cystic lobulations, the individual cysts varying from a few millimeters to 2 or 3 centimeters in diameters. The cyst walls are, for the most part thin and of a purplish hue. On section the tumor structure is suggestive of a sponge with spaces of varying size intercommunicating freely. The dividing septa are of varying thicknesses and these occasionally unite to form fairly solid masses of supporting tissue. Several small calcareous bodies are found in these denser areas. The cyst contents vary from fluid which has the appearance of whole blood to a clear, blood tinged watery lymph.

**Microscopic.** Sections from characteristic portions of the tumor show it to be of hemangiomatous structure throughout. Over the surface of the intravesicular portion is a somewhat irregular layer of bladder mucosa. Occasional thin walled cysts protrude beyond the general level of the mucosa (Fig. 7 C). The vascular channels are lined with adult endothelium and are separated by rather abundant connective tissue. Locally this stroma is dense and hyalinized and in a few places calcified (Fig. 7 D). Remnants of bladder musculature are found among the vascular spaces. Most of the spaces are filled with blood while the remainder contain faintly pink staining fluid or have been completely evacuated. No lymphoid tissue is seen.

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## A Functional Method of Treatment

ROGER ANDERSON, M D, F A C S, Seattle, Washington

**NON-UNIMODAL FRACTURES**, especially the spiral and oblique fractures, the problem of management has always been enhanced because respiration deterred complete immobilization of the elbow joint (Fig. 3). The distal transverse humeral fractures, especially the spiral and oblique fractures, the problem of management has always been enhanced because respiration deterred complete immobilization of the elbow joint (Fig. 3). The distal transverse humeral fractures, especially the spiral and oblique fractures, the problem of management has always been enhanced because respiration deterred complete immobilization of the elbow joint (Fig. 3).

The splint is preferable to the fracture apparatus in that practically perfect apposition can be achieved through mechanical adjustments of an apparatus constructed on an anatomic basis (Fig 5). The anatomic humerus apparatus has been devised so that each fragment can be separately manipulated or rotated in every direction, all upon the normal anatomical axis. Manipulations of the upper fragment are made with the humeral head as the center, while the lower fragment rotates with the center of the shaft as an axis. Besides achieving reduction with mechanical precision, positive apposition is held during roentgenographic examination and the application of the plaster cast.

ROUTINE REDUCTION

Anesthetic of choice is given with the patient supine on a table or cart, with the shoulder *over the table edge*. The new barbiturates administered intravenously is usually successful for intubation of the half pound or less patient. The spinning, whereas the mechanical ventilation performed for the first 15 to 20 seconds generally controlled by an injection of morphine hypodermically. While developing the diagnostic roentgenograms,



Fig 1 Mr W with comminuted shaft fracture. For immobilization only a short cast to the upper arm is necessary, so that the elbow and shoulder joints are left free for immediate movements

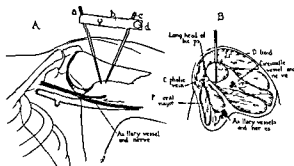


Fig 2 A Half pin unit method of controlling upper fragment. Note distance between the joint capsule and the half pins. Tuberosity half pin *a* which is fastened to but rotates in the clamping bar *b*. Fixation half pin *c*. Fixation lock nut *d*. Both the superior and distal units have been standardized and are made in 3 sizes—child, medium and large. B Cross section of left humerus just beyond acromial process with arm at right angles to the body. The half pin is passed through the humerus from the center of the lateral aspect. Note the distance between the end of the half pin and the brachial vessels.

**Superior half pin insertion.** After the upper fragment has been located by probing with fine Kirschner wire the upper or tuberosity half pin is drilled in with the right hand while the left hand holds the bar parallel to the arm. With the arm in 60 degrees of abduction this half pin is inserted through the skin at a point in the center of the lateral surface of the upper fragment just beyond the lateral edge of the acromial process but with the latest technique both superior half pins are started about 1 inch anterior to the center of the lateral surface and drilled in a medial and posterior direction so that the half pins are never pointed toward the brachial vessels.

The fixation half pin is next drilled in but the cortex is usually so dense that it is advisable to resort to a hand or motor drill. After the half pins have been drilled beyond the medial or opposite cortex the nut on the bar is firmly tightened.

Location and depth of half pin insertions are then roentgenographically checked with the direction of the roentgen rays perpendicular to the half pins. Sterility of the half pin unit is maintained so that if the fixation pin has penetrated the opposite cortex it can be drilled in farther. However if the tuberosity pin should be incompletely inserted it is necessary to withdraw the fixation pin completely before attempting to drill the tuberosity half pin in deeper.

the nerves and arteries are examined for evidence of trauma after which the sides and superior surface of the shoulder and upper arm are surgically prepared. With the humerus in about 60 degrees of abduction the unsterile assistant exerts some manual traction on the forearm at the time the superior half pins are inserted, as shown in Figure 7, A.

The tuberosities should first be accurately located by means of a Kirschner wire used as a probe. When placing half pins, the operator should refrain from pushing too hard until the half pin is well inserted (Figs 2 and 7, A). The

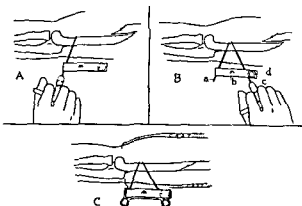
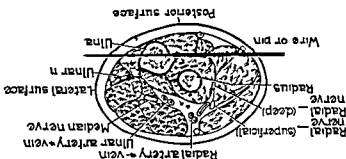


Fig 3 A Distal half pin insertion. In the obese the distal posterior humerus may be outlined by probing with a fine Kirschner wire before the first half pin *a* fastened into the bar *b* though freely turning in it is inserted through the skin at a point in the midline of the posterior surface of the arm at a level one finger's breadth superior to the epicondyles. This half pin is also drilled in while the clamping bar is held parallel to the arm. B The second or fixation half pin *c* is next drilled in either by hand or with the aid of the hand drill then locked in place by tightening the fixation lock nut *d*. If in doubt penetration of the distal half pins may now be checked by fluoroscopic or roentgenographic examination. These half pins should protrude beyond the anterior cortex no harm being done if they protrude well beyond this border. Should the pins need to be inserted deeper follow instructions as detailed for the superior half pins. C The half pin unit is fastened to the distal horseshoe through medium of a short extension after which reduction can be mechanically achieved and permanently held by firmly incorporating the unit in the cast as represented.

hand or electric drill can be used to advantage here as the pin can be rotated fast with only a little pressure exerted until the half pin is well started. These half pins are directed into the shaft in a slightly posterior direction so that if the pin accidentally slips off the bone on starting it passes posterior to the humerus, thus missing the vessels.

Upon roentgenographic check of the depth of both upper half pins, the entire lower arm and elbow are surgically prepared, whereupon the distal half pins are inserted, as illustrated in Figures 7, A, B. If active extensor movements at the elbow are desired the distal half pins are inserted with the elbow in full extension and as soon as the arm is placed in the splint the elbow is immediately and completely flexed so that the triceps tendon and muscle are split around the half pins. By this manipulation, the triceps muscle may later extend the forearm in the normal manner. However, if the distal half pins are inserted in the humerus with the elbow in flexion the movement of extension at the elbow is then



provided these bones are approached from their proper anatomical aspect. Left, above elbow right below elbow

ment in a position midway between internal and external rotation

Apposition is a mechanical achievement. When the roentgenograms reveal as nearly a perfect reproduction as possible, a cast of the best plaster available—padded or unpadded—is applied from the acromial process to below the elbow, *securely incorporating both half pin units (Fig. 7, D)*. The arm is removed from the splint as soon as the plaster sets, whereupon the cast is cut out around the axilla and the elbow joint in order to permit free joint movements. The exposed ends of the half pins and unit may then be plaster-covered.

## AFTER CARE

The cast should be split and spread open over the brachial vessels at the first evidence of impairment of circulation. A procedure is seldom indicated as immediate reduction and absolute immobilization minimize both swelling and shock. The fully dressed patient may leave the hospital on recovery from the anesthetic. If a sling is desired, it should be removed frequently, for the patient must be made to use the arm and move the joints. The arm and shoulder muscles should be both actively and passively exercised. The patient who is unaware of the presence of the cast should be instructed to keep fingers or sticks out of the cast.

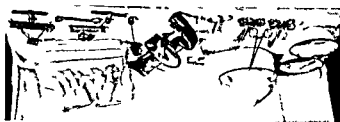


Fig 6 The sterile set up. One basin with ether, the other with  $\frac{1}{4}$  strength tincture of iodine. The drill may be used for the hall pins, or for a Kirschner wire if ulnar transection is desired.

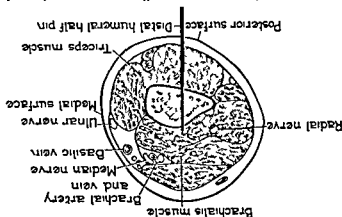


Fig. 4 Both cross sections illustrate practicality of translating either the lower humerus or the upper ulna,

chiefly by the passive movement of gravity. Dry dressings are cut and placed around the pin wounds, with the adhesive tape against the dressings so as to prevent the patient fingering the pin wounds. The dressings are held with a few turns of non-stretching sheepskin tape, but no cotton bands or adhesive tape should encircle the arm. The table that supports the splint should be of such height that the center of the rotating arc is at the center of the shoulder joint. To facilitate this elevation and also to roentgenographic examination we have devised a light adjustable apparatus (Fig. 7, C). The arm is then placed in the anatomic splint, both brackets are swung to the lateral side, with the arm in abduction, the elbow preferably in extension, and the distal frag-

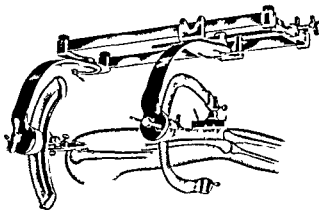


Fig. 3 The anatomical human spine fabricated from some by applying the braces as shown in the figure and may be employed for the arm or child by selecting the appropriate position and rotation are mechanically made at the rigid fossa in the normal manner while the [distal] fragment is manipulated with the center of the shaft as a center

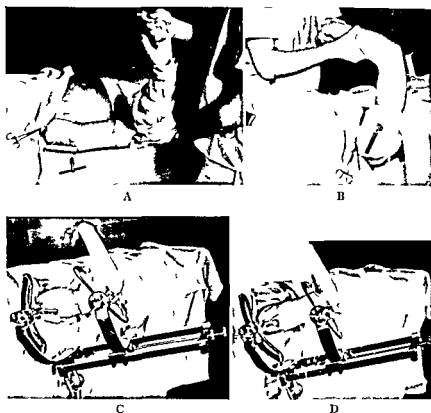


Fig 7 Steps in routine reduction illustrated in the case of Mr S G with fracture in middle one third A Insertion of superior half pins B Insertion of distal half pins C Arm is placed in the splint whereupon an attempt is made to obtain a perfect reduction with end to end contact Fluoroscopic examination assists in achieving normal reposition but is used only to check position no manipulation is done under fluoroscopic screen D Final reduction should be checked with films before plaster is applied

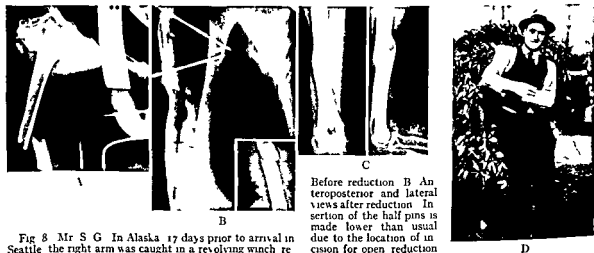
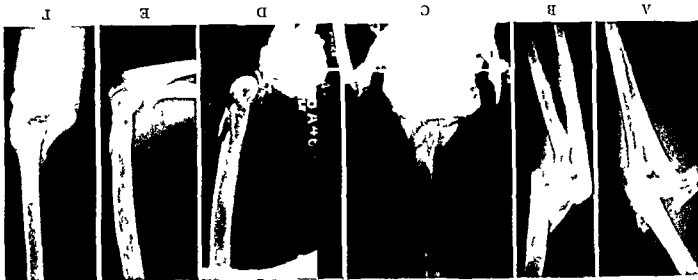


Fig 8 Mr S G In Alaska 17 days prior to arrival in Seattle the right arm was caught in a revolving winch resulting in a fracture of the greater tuberosity dislocation of the shoulder fracture of the shaft and paralysis of the radial ulnar and median nerves Several unsuccessful attempts at reduction under anesthetic had previously been made A

Before reduction B Anteroposterior and lateral views after reduction In section of the half pins is made lower than usual due to the location of incision for open reduction of shoulder dislocation C

Final result D After cast was removed patient fell and re fractured shaft which was again routinely reduced The short arm cast permits maximum exposure for physiotherapy



Röntgenograms should be made a few days after reduction and repeated later to check position and callus formation. It is vital to obtain and maintain end-to-end contact between fragments, even at the expense of some overlapping. Separation from unequal drying of the plaster, or subsequent separation which might be due to late absorption of the fragment ends from circulatory trauma, can be adjusted by the removal of a thin transverse section of the cast, and the recommencing of the plaster segments with a plaster bandage. This correction may be more readily repaired, first, by the replacement of the arm in the splint, A loose cast from recession of swelling calls for no correction, since it is not the tightness of the cast but the incorporated half pins that maintain immobilization. In fact, an entire side of the cast is removable without affecting immobilization. Movements of the arm at the elbow and shoulder joints not infrequently cause some pain due to the pull of the skin against the pins, which friction in turn induces a slight suppuration. This discharge, usually appearing from the second to the fourth week, is of itself no cause for concern as it is only an aseptic reaction from movement of the skin around the pins. If this reaction becomes too annoying, the arm should be kept quiet at the side with the forearm in a sling for a few days' rest. Poor technique, such as failure to transect the humerus completely, or insecure incorporation of the half pins, or the application of inferior plaster, may demand a second reduction.

# REMOVAL OF HALF-PINS

The fracture is immobilized for 6 to 9 weeks, or even longer, depending on callus formation. No attempt should be made to dress pin wounds during

From them ing this time, even when there is a foul discharge. The half pins are removed by first uncovering the ends of the fixation half-pins and exposing the nuts. The cast and sheathadding is then cut around the entire half-pin unit, the nut is unscrewed and the fixation half pin is withdrawn, after which this plaster island with the emmeshed half pin unit is pulled out in the axis of the remaining half pin. Green callus usually calls for some further protection, which is best provided in the form of a posterior molded plaster splint.



Fig 9. Miss E. N., referred by Dr W. I. Frey of Seattle. A and B, Röntgenograms of comminuted T fracture into the elbow joint before reduction. C and D, after reduction with Kirschner wire through ulna for traction. E and F, final result a little over 4 months later. G, illustrates movement of shoulder joint.

G

F

E

D

C

B

A

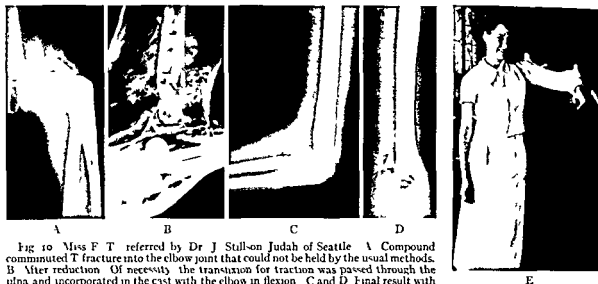


Fig 10 Miss F T referred by Dr J Stallon Judah of Seattle A Compound comminuted T fracture into the elbow joint that could not be held by the usual methods. B After reduction Of necessity the transfixion for traction was passed through the ulna and incorporated in the cast with the elbow in flexion C and D Final result with 75 per cent elbow function E Immobilization with free shoulder movements

#### COMMINUTED FRACTURES

For the comminuted fracture with one or more large loose central fragments the cast should be snugly applied Should the cast subsequently become loosened over these fragments from recession of swelling a longitudinal section of the cast may be removed and the remaining cast circularly compressed In other cases the arm may be replaced in the splint and a longitudinal  $\frac{3}{5}$  or even the whole cast removed and one that fits more snugly re applied

Occasionally it is advisable to make a large fenestration in the cast into which a roll of sheet wadding is fitted so that it can be bandaged down snugly with a circular bandage until the fragment is replaced

#### COMPOUND FRACTURES

Open wounds may be cared for by any standardized method the wound may be debrided and primarily closed, or debrided and packed with Orr's vaseline gauze plus occluding cast the arm with an open wound may be left exposed in the splint for several weeks for treatment by open air maggot or chemical lavage If transfixion is done after debridement a completely new sterile set up should be used

In cases of subsequent abscess formation or sequestration the arm may be replaced in the splint and all or any portions of the plaster removed for required surgery—drainage removal of sequestra or such reconstructive steps as skin or other plastic operations After the arm has been placed in the splint neither removal of the

plaster cast nor moving patient to the x ray or operating room interferes with apposition for the splint securely holds reduction

#### ALTERNATIVE METHODS

The distal transfixion can be placed in the ulna instead of the distal humerus (Figs 4, 9, D 9, G) In this event a wire or a  $\frac{1}{32}$  inch pin is passed through the ulna preferably at a point 1 finger distal to the tip of the olecranon With the elbow at right angles, the wire with its tautner, or the pin is firmly incorporated in a segment of a cast prior to placement in the splint this plaster cast extending from midforearm or midpalm up to about the fracture site Although the distal bracket in this instance is swung from the side to the end position on the splint, nevertheless, all movements are made on the normal anatomical axis Subsequent steps in reduction are similar to those of routine reduction

#### ANOTHER FORM OF TRACTION

A means of obtaining traction without utilizing skeletal transfixion is through the agency of a snug cast from midpalm to about midarm with the elbow at right angles After the plaster sets the elbow portion is fastened into the center of the distal horseshoe with a plaster bandage, after which reduction is carried out routinely

#### SUPRACONDYLAR FRACTURES

Supracondylar fractures in children, irreducible by the usual methods or in adults the comminuted T fractures extending into the elbow



Fig 11 Mr W S referred by Dr Lester Steck of Chehalis, Washington. A mobile accident resulted in a fracture of the shaft with a small compound wound and a large jagged laceration of the upper forearm. Prophylactic tetanus gas gangrene and toxin was injected immediately and the wound was debrided and closed 20 hours before I first saw patient. While removing sutures gas escaped under pressure so that the whole arm was laid wide open, thus necessitating enormous doses of mixed gas and Greene antitoxin to be given intramuscularly and intravenously, 20,000 units in the first 12 hours. Meanwhile, x-ray treatments were administered as advocated by Kelly and I must A, appearance of wound on third day following operation. So much bony gangrenous muscle was resected that the upper end of the distal fragment persisted in protruding through the skin in spite of a body cast so that on the twenty sixth day after the accident, the half pins were routinely inserted. B, Before reduction C, After reduction. The distal half pins were of necessity passed through the skin just adjacent to the wound edge. The slight separation between green fragments was later corrected by removing a thin transverse section of the cast, as outlined in this article D, Three days following the half pin reduction patient up and around. The plaster was extended to the hand for the sole purpose of promoting forearm soft tissue repair.



joint, are reducible and held with this technique, provided the distal transfixion is put through the ulna, as previously detailed.

#### FRACTURE OF THE NECK

The site of fractures of the neck precludes the use of the superior half-pins, therefore, for countertraction, a body cast is applied as far as the hip. This cast should be applied, when possible, edge of the table with the arm held in 75 degrees of abduction. The plaster extends down the arm for a distance of 3 to 5 inches.

When the plaster sets, the patient is placed supine on the table with the shoulder well over the edge of the table. A cast cutter is placed close by, and the anesthetic is given.

Reduction may be obtained by manual traction on the forearm and by manipulating the half-pins, although better results are achieved by employing the apparatus. In this event, the arm stub of the cast is fastened with a plaster band age to the center of the rotating arc when in the neutral or midway position, with the splint at an angle of about 75 degrees to the body cast. Here recovery from the anesthetic

again the adjustable duraluminum floor stand assists materially in attaining quicker and better reduction, which can now be obtained with routine technique. Apposition is held by extending the cast down to the elbow in the form of a spica, incorporating the half-pin unit. The cast in the form of a plaster splint or a wooden splint is prolonged down on the under or ulnar side of the forearm, with the elbow at right angles. This acts as a support to the forearm, at the same time it makes no interference with elbow movements. If desired, traction may be obtained by transfixing the ulna, in which event an arm cast incorporating this transfixion, applied from midpalm to upper arm, with the elbow at right angles. The rotating arc is then attached to the arm stub of the body cast, as detailed above, but the elbow is placed in the splint, with the distal bracket in the end position instead of the usual side position. After reduction, the arm and body casts having been united in a spica cast, the splint is removed. Here again the patient treated in this manner is ambulatory on recovery from the anesthetic.

# HUMERUS FRACTURE COMPLICATED BY FRACTURES OF THE FOREARM

With these multiple fractures, either the distal humeral or the ulnar transfixion acts in a dual capacity first, as traction agent for the humerus fracture and, second, as countertraction agent for the forearm fractures. The humerus should be first reduced as detailed herein and the forearm managed as previously reported (1)

## MALUNION OR NON UNION OPERATIONS

The unsterile splint serves as an admirable fracture table for this type of surgery. Furthermore, as the apparatus consists of stainless steel and duraluminum, it can be sterilized by wrapping in a sheet and placing in the autoclave, to the end that all mechanical manipulations can be made with sterile gloved hands

## PRECAUTIONS

- 1 Locate the fragment by probing with fine Kirschner wire
- 2 Insert the half pins exactly as detailed
- 3 Pierce the opposite cortex by the half pins, as this is essential
- 4 Avoid over traction and maintain end to end contact as this is imperative
- 5 Take sufficient care—Haste makes waste"
- 6 Aim to secure reduction that is roentgenographically perfect
- 7 Apply carefully only the best grade of plaster

- 8 Incorporate half pin units securely in cast
- 9 Remember the fracture committee warning—It is not the splint but the doctor behind the splint that counts in the treatment of fractures'

## SUMMARY

Humeral shaft fractures can be immediately reduced with practically perfect apposition if a specialized form of skeletal countertraction and skeletal traction is employed. Furthermore, this unique system effects complete immobilization, with only a short plaster encasement of the upper arm, both the shoulder and the elbow joints being left uncovered. Accordingly, from the freedom of joint movements and active arm and shoulder muscle exercises provided for, many physiological benefits ensue. It naturally follows that joint stiffness and muscle atrophy are prevented. With a patient fully dressed and the injured arm functioning at his side, many economic benefits are apparent. These advantages are evidenced in a relatively painless convalescence, little after care and a minimum of hospitalization and expense.

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Fig. 1 Malignant adenoma of the thyroid gland with tumor tissue growing down the inferior thyroid vein (Surgical specimen)

roid vein and if this is followed by a complete lobectomy, dissemination of the tumor by manipulation at operation will be avoided.

In a series of 49 cases of malignant adenomas there were 20 local recurrences of the tumor. In 8 cases the recurrent tumor was excised and in 4 of these 8 cases the recurrence could be definitely demonstrated to be within the veins of the neck. Thus, in half the cases in which local recurrences were excised the tumor was demonstrable in the veins of the neck.

The accompanying photomicrograph (Fig. 3) of a local recurrence of a malignant adenoma and the pathologist's description of the gross specimen indicate how clearly these recurrences can be shown to have taken place in venous channels. This patient is still alive and apparently free from cancer 7 years after excision of the recurrent tumor.

*Examination of gross specimen.* Specimen consists of a tumor mass removed from the left side of the neck in the region of the left thyroid lobe, weight 10 grams. It measures 4 by 2.5 by 2 centimeters.

The external and anterior surfaces are covered by muscle, fascia and fat. The mesial surface is made up in part by a wall of the large vein and by capsule of tumor tissue. The upper extremity of the mass consists of a cross section of a vein 7 millimeters in diameter. This extends downward along the anterior and mesial surface of the mass for a distance of 1 centimeters. The whole segment of vein appears to be filled with a solid, pseudo-lobulated, firm, whitish tissue containing very little colloid. The lower end of this segment of vein is relatively free from tumor thrombus and measures 8 millimeters in diameter. This segment of vein and its included tumor tissue make up the greater portion of the specimen.

Running obliquely from the anterior border downward and backward across the mesial surface there is another cord-like structure varying from 3 to 7 millimeters in diameter. Examination of the anterior and upper end of the structure shows it to be definitely a blood vessel with the openings of branches into the lumen. Below this point for a distance of 2 centimeters this structure is occluded by tumor tissue.

Projecting from the inferior pole of the specimen there is another vascular channel probably filled with tumor tissue.

Along the inferior portion of the posterior border of the specimen is an apparently encapsulated nodule of tumor tissue 1.5 centimeters in diameter. From the lower pole of this there emerges a small tubular structure apparently a vein. The dissection indicates that practically all the tumor tissue is confined within veins. There is some question about perforation and local infiltration at the lower pole of the specimen.

It is probable that the main venous channel is a segment of the internal jugular vein. Other channels may be branches of the lateral thyroid veins.

Since resection of the venous channels draining the affected lobe of the thyroid eradicates the most common site of recurrences, it is clear that both distant metastasis and local recurrence of malignant adenomas of the thyroid should be diminished if the veins into which the tumor so frequently extends are resected along with the tumor mass.

#### TECHNIQUE

Since the possibility of carcinoma is occasionally suspected when carcinoma is not present, it is clear that the incision for exposure of a suspected thyroid carcinoma should be made in such a way as to leave an ordinary collar incision scar if carcinoma is not found. At the same time the incision should be placed in such a manner as to allow for its extension to give the wide exposure that is necessary for the radical operation if malignancy is encountered. The incision that most closely approaches this ideal is a high wide transverse incision made at the level of the cricoid cartilage.

After the skin incision is made the skin flaps are dissected upward and downward to enable the



Fig. 3 Photomicrograph of malignant adenoma recurrent in veins of neck. (Surgical specimen) (X 8)

occasion being just above the insertion of the muscles into the sternum (Fig. 5). A careful attempt is then made to separate these muscles from the underlying capsule of the thyroid, and if they are not adherent, they are elevated like a trap door, and retracted laterally to expose the thyroid and the carotid sheath (Fig. 6). If the muscles are adherent to the capsule of the thyroid and their separation from the thyroid would entail risk of cutting into tumor tissue, it is better not to attempt this separation but to connect the lateral ends of the two transverse incisions by a vertical incision, expose the jugular vein by this means, and resect the overlying muscles along with the lobe of the thyroid. Before any further manipulation of the tumor is attempted, the internal jugular vein should be isolated, doubly ligated, and severed low in the neck and again ligated and severed at a level just above the point of entry of the superior thyroid vein (Fig. 6). The inferior thyroid vein likewise should be ligated and severed as far as possible from the tumor. The inferior thyroid vein and the internal jugular vein with the superior and middle thyroid veins are then dissected out and are resected along with the entire affected lobe of the thyroid. In the course of the lobectomy, no attempt should be made to isolate or to preserve the recurrent laryngeal nerve. Such attempts result only in unnecessary manipulation with attendant liability to dissemination of the tumor



Fig. 2 Photomicrograph of malignant adenoma growing in a vein (X 95)

operator to separate the pretracheal fascia and muscles in the midline and examine the thyroid gland. This examination is carried out gently and with care not to break the capsule of the gland. If it is evident that the tumor is malignant, the skin incision is extended vertically from the mid-point of the lower flap straight down to the suprasternal notch (Fig. 4). The skin flap including the subcutaneous fat is then dissected free of the platysma and deep cervical fascia on each side and is retracted. The pretracheal (sternothyroid, sternohyoid, and omohyoid) muscles are separated in the midline from the thyroid cartilage to the suprasternal notch. The muscles and cervical fascia on the side of the tumor are clamped and divided transversely as high as possible, so as to afford adequate exposure of the superior pole. At this level the sternomastoid is usually well lateral to the tumor and hence need not, as a rule, be divided. The sternomastoid, the pretracheal muscles and the cervical fascia are again clamped and divided transversely, the line of section on this

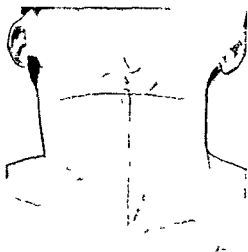


Fig. 4. Lines of skin incision

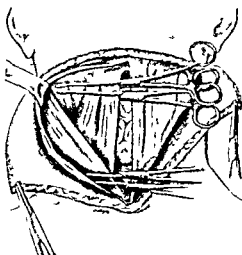


Fig. 5. Skin flaps elevated and muscles clamped preparatory to their division and reflection laterally

The slight hoarseness that results from paralysis of one vocal cord is a negligible consideration as compared with the possibility of recurrence of the tumor

It is usually advisable to ligate the arterial blood supply of the thyroid before liberating the gland from the trachea. The superior and inferior thyroid arteries are isolated, clamped, and divided well away from the gland in order to avoid manipulation of the tumor. The isthmus is then divided and the affected lobe is carefully dissected free from the trachea. It is best to make a sharp dissection at this point and to avoid placing clamps on the tumor even if slight oozing does occur. If the tumor has not extended through the capsule posteriorly, this procedure will allow the gland to be mobilized and from this point on it is easily removed.

During the course of the operation the capsule is not broken by the insertion of hemostats or traction clamps. Any desired rotation of the gland from its bed being obtained by inserting the finger behind the tumor and drawing it forward.

At the close of the operation the trachea and the carotid artery on the affected side are bare (Fig. 7). When there is extensive bilateral involvement, a condition which usually occurs only in advanced and incurable cases, the tumor is frequently fixed to the trachea and has invaded all contiguous structures. This type of tumor can rarely be removed completely and a radical operation is therefore not only dangerous but futile. In any case, bilateral ligation of the internal jugular veins should not be performed at the same operation.

Although this technique for the radical removal of a malignant adenoma of the thyroid gland is probably the most effective means of obtaining a permanent cure, unfortunately, only the minority of patients are seen early enough to permit complete excision of the tumor. When complete excision cannot be accomplished, it is still of value to ligate the jugular vein, excise as much of the tumor as possible, implant radon seeds in the remaining portions, and treat with deep roentgen ray.

#### INDICATIONS FOR OPERATION

1. *Prophylaxis* Over 90 per cent of all malignant tumors of the thyroid gland originate in pre-existing adenomas (3). Therefore, in the vast majority of cases, prompt and complete removal of adenomas of the thyroid will protect the patient against the development of a malignant tumor.

It is impossible to determine by any clinical test the exact time at which a benign adenoma becomes malignant, but since nearly 1 per cent of all adenomatous goiters removed are found to contain malignant tumors that were not diagnosed before operation (2), the time to remove a discrete adenoma is as soon as the diagnosis is made. The risk in the removal of a simple adenoma is negligible; 1 fatality having occurred in our last 1,400 cases. On the other hand, the risk of leaving an undiagnosed cancer is considerable and, as has been shown, will occur approximately once in a hundred times if adenomas are not removed.

A distinction should be drawn at this point between the diffuse adenomatous goiter and the discrete adenoma of the thyroid. In the former,

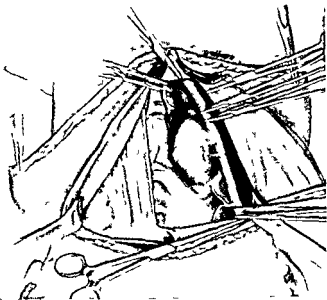


Fig. 6 Muscles reflected to expose tumor of thyroid gland. The internal jugular and inferior thyroid veins are doubly clamped preparatory to their division and resection.

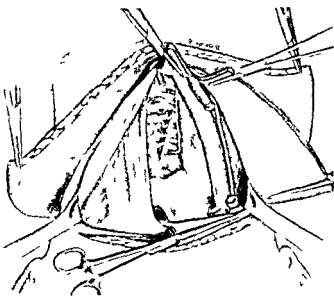


Fig. 7 The entire lobe of the thyroid is removed. The ligated stumps of the internal jugular and inferior thyroid veins and the stump of the superior thyroid artery are seen. The carotid artery and the right side of the trachea are bare. (Note—Although the recurrent nerve is not usually visible from this angle, its approximate course is indicated in this drawing.)

rapidly and can always be demonstrated by roentgen examination. Chronic thyroiditis is sometimes mistaken for malignancy but as a rule the tenderness of the gland, the pain on swallowing, and the relatively small size of the tumor mass will make the diagnosis clear. In any case it should be remembered that it is far safer, in view of the hopeless prognosis of incompletely removed cancers, to treat a suspected malignancy as a malignant tumor and perform the radical operation.

**3 Indications for palliative procedures.** Extensive bilateral involvement of the thyroid by a malignant tumor is usually associated with invasion of contiguous structures and indicates incurability. Likewise, paralysis of one or both vocal cords before operation shows extracapsular extension. There is no case in the Cleveland Clinic series in which a permanent cure has been obtained when laryngeal paralysis was present before operation.

Pain associated with a malignant tumor of the thyroid is likewise an unfavorable prognostic sign. No permanent cures resulted in a group of 7 patients who complained of pain. Pain does not, as a rule, occur until invasion of the capsule and cervical plexus has taken place. Similarly, fixation of the tumor signifies that the disease is incurable. In the presence of one or more of these signs or in the presence of demonstrable metastases in the

tumor cannot be distinguished from an early malignant tumor. It is this type of adenoma which is clearly excised. In such cases there is a definite tendency for the gland and the adenoma should be removed. In certain circumstances, however, the logical process of degeneration and regeneration is that something more than a generalized physiologic process is occurring, then it is clear that these adenomas are enlarging, and particularly from the remainder of the gland, and particularly from the remainder of a consistently different gland, discrete adenoma or even of several discrete nodules which are of a consistency different from the remainder of the gland, and particularly from the remainder of a consistently different gland. On the other hand, if the goiter consists of a single, discrete adenoma or even of several discrete nodules which are of a consistency different from the remainder of the gland, and particularly from the remainder of a consistently different gland, it is not necessary provided she will agree to return for periodic observation.

**2 Indications for radical operation.** In patients over 40 years of age, a history of recent enlargement of a pre-existing goiter and the finding of a stony hard, uncalcified tumor in one lobe of the thyroid is indication for a radical excision of the affected lobe and its venous tributaries by the technique that has been described previously. Occasionally a calcified adenoma will prove confusing but such an adenoma rarely enlarges.

lungs or bones, a radical operation is futile. In these cases, we must rely on radiation therapy for palliation. It is nevertheless advisable to perform a biopsy to rule out the possibility of an atypical thyroiditis. When this is done, it is well to sever the preglanglular muscles transversely so that the tumor may come forward thus releasing the pressure on the trachea. Such a decompression will sometimes give symptomatic relief but will not alter the course of the disease.

In some instances, the dyspnea incident to invasion or compression of the trachea by a carcinoma of the thyroid is sufficient to demand an immediate tracheotomy. The procedure is often technically difficult as a result of the necessity of making the opening below the site of compression or invasion. In addition, there may be a large mass of tumor tissue overlying the trachea, the resection of which results in troublesome bleeding. Tracheotomy is therefore a serious undertaking and in advanced cases the mortality rate from pneumonia is high, particularly when pulmonary metastases are present.

#### PROGNOSIS

The only two types of malignant tumor of the thyroid that are curable are fortunately the two most common—the malignant adenoma and the papillary carcinoma. In all other types, i.e., the scirrhous carcinoma, the lymphosarcoma and the spindle cell sarcoma, there is little or no prospect of permanent cure by surgery.

*1. Prognosis in cases of malignant adenoma.* Forty nine cases of malignant adenoma were selected for study. In all these cases sufficient tissue for definite classification was available, the histories were complete and the follow up was complete to the time of the patient's death or to the fourth year after operation. Twenty six per cent of these patients were alive and apparently free from cancer from 3 to 17 years after operation, an average cancer free survival period of slightly over 7½ years.

At the end of 3 years 43 per cent were alive, 2 per cent had died free from cancer and 55 per cent had died from cancer. Deaths in the hospital following operation were included in this percentage.

At the end of 5 years 35 per cent were alive, 2 per cent were alive at the last report but had been lost in the follow up, 2 per cent had died of other causes and apparently were free from cancer, and 61 per cent had died from cancer.

At the end of 10 years, 68 per cent of the patients were dead from cancer and at the end of 15 years 70 per cent were known to be dead from cancer.

In the majority of the cases in this series, a course of radiation therapy was given after operation and in some instances this appeared to hold the disease in check. On the other hand, it is extremely difficult to evaluate the effects of roentgen therapy because of the great variability in the natural course of the disease. One patient, for example, to whom roentgen therapy was never given, is alive and apparently cancer free more than 6 years after the original operation and more than 2 years after the excision of the second of two local recurrences in the veins of the neck. Had this patient been given roentgen therapy her longevity might well have been ascribed to this treatment.

Excision of the veins of the neck was not performed routinely in this series of cases and sufficient time has not elapsed to allow any evaluation of the results of the radical operation. There are, however, 4 cases in which the internal jugular vein on the affected side was ligated or excised at the time of operation. In one of these, complete removal of the tumor was impossible, and the patient died within a month as a result of a local recurrence. The other 3 patients, in each of whom a section of the jugular vein was excised, all lived more than 9 years. Generalized metastases developed 8 years after the original operation in 1 patient, the second patient died apparently free from cancer 8½ years after operation and the third is cancer free 17 years after the original thyroidectomy. Although the numbers are too few to be of statistical value, the 75 per cent 5 year survival rate in this small group compares favorably with the 55 per cent 5 year survival rate of the group in which the veins were not excised.

Detailed studies of the group of 49 cases of malignant adenoma clearly indicate that the prognosis is dependent more on the extensiveness of the tumor and on the operator's ability to excise it completely than on the age of the patient, the duration of the recent enlargement of the goiter, the extent of micro-copic invasion of blood vessels or the degree of anaplasia of the tumor as based on histological grading.

*Age.* Fifty per cent of the patients under 45 years of age lived 3 years after operation, and 50 per cent of those over 55 lived 3 years after the operation.

*Duration of enlargement of goiter.* If the duration of the recent enlargement of a pre-existent quiescent goiter is taken as a measure of the duration of the cancer before operation it is found that the patients in whom the duration of the enlargement was the longest responded

TABLE I.—RELATIONSHIP OF COMPLETENESS OF EXCISION TO SURVIVAL AFTER OPERATION

Number of deaths in less than 3 years after operation	Incomplete excision	
	3	19
21		6

The completeness of excision of the tumor. By far the most reliable index of prognosis in this series was the completeness or the incompleteness of the excision of the tumor. In those cases in which the operative notes indicated that the patients were alive at the end of 3 years 76 per cent of the patients were alive at the end of 3 years whereas only 12.5 per cent of those in whom the excision was incomplete were alive at the end of this period. The outlook for the patient in whom the disease is in a sufficiently early stage that the tumor can be excised to the satisfaction of the surgeon is therefore six times as good as that of the patient in whom complete excision of the tumor is rendered impossible by its extensiveness or invasiveness (Table I). The impression of the surgeon as to whether or not he was able to remove the entire tumor is the most valuable single criterion for determining the prognosis in cases of malignant adenoma of the thyroid.

*2 Prognosis in cases of papillary carcinoma*  
The papillary carcinoma of the thyroid gland occurs until the tumor is locally incurable, radical excision of the lymph glands of the neck is futile. The prognosis in this type of tumor is definitely better than in the malignant adenoma. Fourteen patients with the papillary carcinoma were followed for a period of 3 years or more after the operation or until death occurred. Twenty-one per cent of these patients died of cancer in from 1 to 3 years after operation. Two patients (17 per cent) died of causes other than cancer 30 months and 35 months, respectively, after operation, and the remainder (64 per cent) are alive from 3 years to 13 years after operation, an average survival period of slightly over 8 years. A clean excision of this type of tumor, therefore, gives excellent promise of a permanent cure. Moreover, since extension into the veins of the neck does not occur, resection of the veins is not necessary. Unfortunately, there is no certain way of differentiating

better. Thirty-one per cent of the 16 patients who had first noticed enlargement of a pre-existing goiter or who had first noticed a goiter less than 4 months before entry were alive at the end of 3 years as compared to 55 per cent of the patients who had noticed enlargement of the goiter for more than 4 months. The explanation for this somewhat surprising finding is not clear, but it is possible that the invasive and incurable tumors give symptoms earlier as a result of extension to contiguous structures and hence impel the patient to seek aid earlier than do the non invasive varieties.

Invasion of blood vessels. It was found that 55 per cent of the patients in whom microscopic examination showed evidence of invasion of the blood vessels by tumor tissue were alive at the end of 2 years as compared with 40 per cent in whom lesser degrees of blood vessel invasion was demonstrable microscopically. The explanation for this surprising finding may be that the rapidly growing, invasive, and anaplastic tumors destroy the capsule and its vessels with such rapidity that the blood vessel invasion is not easy to demonstrate, whereas the more slowly growing malignancies tend to grow in the lumen of veins without invading and destroying their walls. In cases in which tumor thrombosis of veins was visible on gross examination, the prognosis was found to be somewhat worse than in the cases in which gross evidence of blood vessel invasion could not be detected. Gross invasion of the blood vessels is often associated with extension of the tumor probably into the veins of the neck, a condition which is incurable unless these veins are resected with the tumor. Anaplasia and rate of growth. The tumors were graded histologically as to their degree of anaplasia and rate of growth, I being the slowest growing and the most differentiated tumors and grade IV the anaplastic and rapidly growing tumors. It was found that in the patients who died in less than 2 years, the tumors were more anaplastic (average grade 2.33) than were the tumors in the patients who survived over 3 years (average grade 1.81). In spite of these findings, the correlation in this respect was not striking and a number of exceptions to the rule occurred. For example, 2 patients with grade IV carcinomas were alive at the end of 3 years and 4 with grade I carcinomas were dead at the end of 2 years. Thus, although there was found to be a definite relationship between the survival period of the patient and the degree of differentiation of the tumor, this was not as uniformly striking as might be expected, and the degree of differentiation in determining prognosis in culture satisfactory in the majority of cases.

before operation between a malignant adenoma and a papillary carcinoma. Since the malignant adenoma is nearly five times as common as the papillary carcinoma, it is best to deal with all malignant tumors as if they were malignant adenomas and resect the veins of the neck along with the tumor.

#### CONCLUSIONS

1 The malignant adenoma is the most common malignant tumor of the thyroid gland.

2 The malignant adenoma and the papillary carcinoma are the only types of malignant tumor of the thyroid gland that, in our experience, have been cured by surgery.

3 Since the malignant adenoma is the most common type of thyroid malignancy and is nearly five times as common as the papillary carcinoma, any malignant tumor of the thyroid gland should be considered as a malignant adenoma until proved otherwise.

4 The malignant adenoma extends into metastasizes through, and tends to recur in the veins of the neck.

5 A description is given of the technique of an operation that is designed to excise a malignant

tumor of the thyroid gland and the veins that drain it.

6 Excision of the veins of the neck removes the zone into which malignant tumors of the thyroid gland most commonly extend and recur, and is comparable to axillary dissection in carcinoma of the breast.

7 The prognosis in malignant adenoma and papillary carcinoma is fairly good if complete excision can be accomplished. The prognosis was excellent in a small group of cases in which the jugular vein was excised with the tumor.

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**ECTOPIC** literally means "out of place." By definition an ectopic kidney is one that owes its position to developmental failure. It has been arrested in ascent during embryonic life and usually has failed to

Brasch (3) described the ectopic kidney as one below the level of the second or third lumbar vertebra and he pointed out that it may be

The uterus of the ectopic kidney is always short laterally, and often there is a tendency to duplicate the calyces may extend anteriorly, medially, or posteriorly as usually anterior and bizarre in outline. The pelvis of an ectopic kidney is usually acquired renal pelvis.

# EMBRYOLOGY OF THE KIDNEY

Huntington and Pohlman have each given a clear cut and readily understandable explanation

[illegible]

The kidney's migrate upward, following the line of the degenerating mesonephros, and a rotational occurs at the millimicron level in the 17 millimicron embryo. The kidneys acquire their permanent blood supply when the normal position is reached at the end of 25 to 30 human embryos or at the end of the second month in the course of the kidney's ascent its blood supply is derived from several temporary sources, any of which may become permanent renal vessels should ascent be arrested.

and the amount of cortex as the normal opposite kidney. In rare instances the abnormal development affects the cortical portion of the kidney as well as the calyces and pel-

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is, resulting in congenital hypoplasia and sometimes, although rarely, agenesis. As a general rule, a rotation does not occur in ectopic kidneys, and the pelvis remains anterior to the calyces, which produces a bizarre urographic picture that might by the inexperienced eye be misinterpreted and lead to an erroneous diagnosis of renal neoplasms.

Campbell reported the incidence of ectopic kidney at necropsy as 1 in 660 individuals and Barton, in 1936, reported 22 cases in 22,000 necropsies performed at the University of Minnesota, or an incidence of 1 in 1,000, in their series. 7 were pelvic kidneys, 3 lying across the body of the pelvis proper and the remainder lying in the lower iliac fossa. Thomas and Barton reported clinical incidence of ectopic kidney as 1

In reviewing the records of all cases of ectopic pregnancy encountered at The Mayo Clinic up to February 1, 1936, we were able to find a series of 167 cases. Nine of these cases were encountered (or about 1 in each 1,200 necropsies), the remainder 88 were seen clinically. In 52 of these 88 cases the uterus was established during the course of the necropsy examination. In the other 36, the diagnosis was made at the time of initial examination. These 36 cases were distributed as follows:

examined or treated at the clinic included in this series of 97 cases are 3 previously reported by Braasch (2) and 19 previously described by Judd and Hartington. We have included them in order to make the report complete. The discrepancy between the incidence at necropsy and that at clinical examination suggests that many ectopic kidneys do not cause symptoms.

Գործընկերները համաձայնեցին, որ իրենց ընդհանուր շահերը պահպանելու համար չեն փորձում իրար հակադրել, քանի որ իրենց համագործակցությունը հիմնված է ընդհանուր շահերի վրա:



Fig. 1 Pyelogram of a left ectopic kidney located in the pelvis showing the short ureter and bizarre arrangement of the calyces

#### LOCATION OF THE ECTOPIC KIDNEY

In the 88 clinical cases there was no great disproportion in location of the anomalous kidney as regards the left or right sides. It occurred on the left side 40 times, on the right side 46 times, in the 2 remaining cases there was bilateral ectopy. In the small series of cases at necropsy there was more disproportion, the left being the site of the anomaly five times and the right twice, the 2 remaining patients having fused kidneys.

In describing the location of the ectopic kidney, we have employed three terms, 'pelvic,' 'iliac,' and 'abdominal.' By 'pelvic' we mean a kidney that is located in the true pelvis (Figs. 1 and 7), by 'iliac' one that is found either in the iliac fossa or opposite the crest of the ilium (Fig. 2), and by 'abdominal' one that is fixed either below the level of the second or third lumbar vertebra and above the crest of the ilium (Fig. 3) or one fixed far laterally in the abdomen (Figs. 4 and 5).

In the series of 88 clinical cases there were 56 examples of pelvic kidney, 7 of iliac kidney, and 25 of abdominal kidney, whereas in the series of 9 necropsy cases there were 5 examples of pelvic kidney, 2 of which were bilateral, forming the so called shield or cake kidney, (Figs. 6 and 7), 1 of iliac kidney, and 3 of abdominal kidney.



Fig. 2 Pyelogram of a right ectopic kidney opposite the crest of the ilium. The renal pelvis is anterior and the calyces are directed mesially.

#### STATUS OF THE OPPOSITE KIDNEY

The opposite kidney was normal as far as any developmental anomaly was concerned in 81 cases, it was congenitally absent in 8 cases and abnormal in 8.

The anomalies found in the opposite kidney in the 8 cases were as follows: fetal lobulation in 1 case, duplication of the renal pelvis in 1, incomplete rotation in 2, and bilateral ectopy in 4 cases. Two of these cases in which bilateral ectopy was present were observed clinically, whereas the other 2 were found at postmortem examination, the death of the patients having had no relation to the anomalous renal condition.

#### SOLITARY ECTOPIC KIDNEY

Congenital absence of the kidney opposite the ectopic kidney, as was previously stated was noted in 8 cases. The fate of this opposite kidney during embryonic life provides an interesting though hardly profitable subject for speculation.

Treatment in such cases was of necessity conservative, and at this point it is well to stress the importance of proving the existence and good function of the opposite kidney before any treatment of an ectopic kidney is begun, especially if nephrectomy is contemplated. In a fair proportion of cases the diagnosis of ectopic kidney will be made during surgical exploration for a supposed

pelvic or abdominal tumor. In such event the ectopic organ must be treated conservatively, if at all, unless during exploration the surgeon can satisfy himself that a normally functioning opposite kidney is present.

#### BILATERAL ECTOPIC KIDNEY

True bilateral ectopy of the kidney is indeed rare, and many alleged examples are in reality unilateral fused kidneys. In our opinion, in cases of unilateral fused kidney one kidney is in a position which cannot be considered abnormal, hence the condition is really not one of bilateral ectopy.

McCorm, in 1929, collected 24 cases of bilateral renal ectopia from the literature and added 2 of his own, which made a total of 26. Coppinger, in 1934, reviewed the literature and found 21 cases of bilateral pelvic kidney, he added 1 case of his own, which made a total of 22 cases. In the present series we encountered 2 clinical cases and 2 postmortem cases of bilateral ectopia, and we think that 1 of the clinical cases is of sufficient interest to justify a brief review of the history.

The patient in this case was a white, married man, 48 years of age, who came to the clinic on May 13, 1935. His chief complaint was pain in the left side of the abdomen which had begun following mild trauma to the lower part of the abdomen 10 years previously. This pain had been intermittent in type and had occasionally been projected into the medial aspect of the left thigh and leg, it was accompanied by a desire to defecate, urinate, and vomit. There had been no chills or fever. The electrolytic program showed the left renal pelvis to be opposite the third fourth, and fifth lumbar vertebrae and adjacent to the spinal column and overlying the transverse process of the first sacral vertebra. There was a stone 2 centimeters in diameter, at the ureteropelvic junction causing marked pyelectasis (Fig. 8, a). The right kidney was not visualized in the intravenous urogram. A retrograde pyelogram showed the right renal pelvis to be located over the mid portion of the sacrum just to the right of the midline, and it was dilated grade 1+ (Fig. 8, b). Specimens of urine obtained from each kidney contained no pus, nor were organisms grown on culture of the urine. Left pelvic lithotomy was performed through a left inguinal incision. There was no evidence of fusion of the kidneys. Con-  
valescence was uneventful.

#### ASSOCIATED ANOMALIES OF OTHER ORGANS

Guzzetta stated that anomalies of the genitalia are present in a third of the cases of renal anomalies. Olson and Adams and others reported variations in the female pelvic organs in association with cases of ectopic kidney in which the jejunum, ileum, and ascending and transverse colons were found to be suspended by a common mesentery, the root of this mesentery was attached for 2 inches (5 centimeters) around the superior mesenteric artery.

Fig. 3. Retrograde pyelogram of a right ectopic kidney in fixed position just lateral to the third and fourth lumbar vertebrae. The ureter is inserted lateral to the calyces, which are directed medially.



The testis was lodged against the kidney and the right inguinal canal contained the processus vaginalis, extending from the right inguinal ring to the bottom of the scrotum. Below the external ring the vaginal process was obliterated, whereas that portion within the canal was patent and contained a small peritoneal sac. Peterman, in examining at necropsy an infant 8 months old who had an ectopic right kidney, found absence of the spleen and left kidney, although the left suprarenal gland was in its normal position. The stomach was fetal in type, tubular, and had a capacity of about 60 cubic centimeters. These are merely examples, however, and no attempt has been made by us to collect and describe all of the anomalies that have been recorded in the literature in association with ectopic kidney. In the present series of cases anomalies elsewhere in the body were encountered in 1 necropsy case and in 12 of the clinical cases. The anomalies found in the cases of 9 women were as follows: absence of the vagina in 1 case, congenital small vagina in 1, infantile external genitalia in 1, complete absence of the uterus,



Fig 4 Retrograde pyelogram showing an ectopic solitary kidney fixed in the abdomen far lateral to and below its normal position the lower calyces are very short. The left kidney was proved absent by cystoscopy and intravenous urography



Fig 5 Intravenous urogram showing an abdominal type of ectopic kidney. The pelvis lies anterior to the calyces although accentuation of the media contained in them makes the calyces seem anterior

oviducts and ovaries in 1 absence of the body of the uterus and a rudimentary horn on the left in 1, bicornate uterus in 1 absence of the right broad ligament and right oviduct and ovary in 1, congenital malformation of the pelvic organs of an unspecified type in 1, and congenital malposition of the right suprarenal gland (which was adherent to the liver) in 1

The anomalies found in the cases of 4 men were as follows: absence of the frontal sinus in 1 case undescended right testis in 1 congenital malformation of the liver and duodenum in 1 and transposition of the sigmoid and descending colon in 1

It is quite probable that various other anomalies existed which were not noted during the course of examination and treatment; however, we have listed all those which were noted on careful study of the records

#### SYMPTOMS

An ectopic kidney may become the seat of the same diseases to which a normally placed kidney is subject. In many of the cases in this series there were apparently no urologic symptoms. Ten patients suffered dysuria, frequency or hema-

turia, but such symptoms certainly were not related to the anomaly, rather they were due to *intercurrent infection or calculus*. Twenty nine of the patients gave a history of pain, and only 5 others were conscious of a tumor.

The fact that 29 or 32.9 per cent, of the 88 patients observed clinically suffered from recurrent attacks of pain is evidence that drainage from an ectopic kidney is often incomplete. This may result from the fact that free drainage of urine through the ureteropelvic juncture is prevented by anomalous blood vessels or constricting bands of capsular or peripelvic tissue. In most cases the pain complained of was not projected to the lumbar region in the fashion usually noted when a diseased kidney is in normal position. This is of course not strange since, for instance, an ectopic pelvic kidney could hardly be expected to cause pain high in the lumbar region. In the majority of cases, therefore, the pain was of an atypical or bizarre nature and its projection was as a rule peculiar. One patient, a boxer by profession, who had a pelvic kidney which functioned normally, thought he noted an indescribable sensation develop low in his abdomen whenever he skipped



Fig 6 Bilateral ectopic kidneys which were fused to form a "shield" or "cane" kidney that lay in the pelvis between the iliac vessels

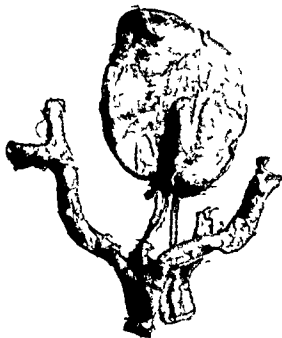
the rope during the course of his pugilistic training. His great success at his chosen calling, however, definitely disproved any disability from the renal anomaly.

#### TREATMENT

In the majority of cases in this series there seemed to be no indication for treatment of any kind, for the ectopic kidney was functioning normally and as far as could be determined was not a detriment to the patient's health. In a few cases an existing pyelonephritis was treated in the usual manner. In the absence of a degree of disability which justified surgical exploration, treatment other than for infection was rarely attempted.

Theoretically it should be possible with bougies or bulbs passed through the cystoscope to dilate the ureter and thus improve drainage and relieve

Fig 7 I used bilateral ectopic kidneys lying below the iliac vessels



mild pains which possibly originate in an ectopic kidney, but as a matter of actual practice greater harm than good generally results from such efforts. In an occasional case a ureteral catheter was passed and was left in place for a number of days, apparently with benefit for mild pain disappeared. It is possible, however, that the improvement was of psychic origin.

Twenty-one surgical procedures were performed on ectopic kidneys in this series, 17 of which were nephrectomies and 4 pyelolithotomies. It will be recalled that the diagnosis of ectopic kidney was established at the time of surgical exploration in 36 cases. In several of these cases exploration of an abdominal or pelvic tumor, the existence of an ectopic kidney was entirely unsuspected and preoperative pyelograms had not been made. In view of the fact that the kidney was normal except for its anomalous location, nephrectomy was therefore deemed unnecessary.

In several other cases gynecological or other abdominal conditions were the primary reasons for operation, and the ectopic kidney, with its congenital anomalous blood supply, bared position, and short ureter, was noted as an incidental finding. It is of course necessary to distinguish such kidneys from the ordinary low-lying kidney which is regarded as true renal ptosis. The latter type of kidneys are freely movable, have a normal

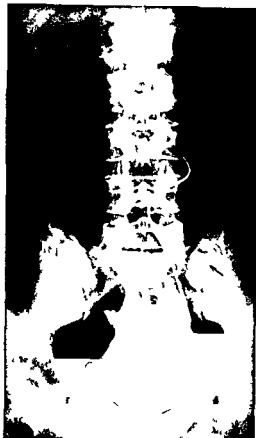


Fig 8 a left Intravenous urogram showing marked hydronephrosis in a left ectopic kidney containing a stone (the stone is better visualized in the pyelogram to the right) b Retrograde pyelogram of a right ectopic pelvic kidney showing a stone overlying the left side of the sacrum just laterad to the lead catheter

blood supply, and can be readily restored to their position in the renal fossa. We have carefully excluded all such cases from our series.

One patient presented himself with a urinary fistula draining in the left groin. This had followed operation, elsewhere, at which time a portion of a tumor had been excised and drainage instituted. It was evident that the lesion was a hydronephrotic ectopic kidney, and complete nephrectomy eliminated the complaint.

Nephrectomy was performed in another case for a hypernephroma, weighing 2200 grams, in a pelvic ectopic kidney. Prior to operation the lesion had been thought to be an ovarian tumor. Recovery was uneventful.

In 2 cases the ectopic kidney was the seat of tuberculous infection and nephrectomy was followed by complete recovery from a previously intractable cystitis. It seemed to the surgeon at

the time of exploration in 5 cases that the ectopic kidney was more or less atrophied, and that this probably accounted for the symptoms of which the patient complained, hence nephrectomy was performed.

Hydronephrosis combined with either infection or stone was the reason for nephrectomy in 8 other cases. One might think that some variety of plastic operation on the distended renal pelvis might be considered, or that ligation of a blood vessel or division of a band of tissue causing obstruction might effect a cure. As a matter of fact, however, these procedures are unwise, and simple removal of a stone, if it is present and renal function is good, or nephrectomy, if the condition of the opposite kidney permits, seem definitely better forms of surgical treatment. In 1 of the cases in this series ligation of a blood vessel had no effect whatever on the patient's symptoms, even though



Fig 9 Intravenous urogram showing hydronephrosis in a left ectopic kidney situated in the pelvis, and showing the deformity of the bladder, apparently caused by pressure of the adjacent kidney



Fig 10 a Left plain roentgenogram showing a stone in the upper group of calyces

drainage from the kidney was definitely improved as a result of the operation, several months later nephrectomy was performed, with complete relief. It was necessary in 1 case to perform permanent nephrostomy because the opposite kidney had insufficient function to sustain life.

#### PATHOLOGICAL FINDINGS

An attempt was made to study the frequency of infection of urine from ectopic kidneys as well as the presence of hydronephrosis, pyonephrosis, and stone. We did not consider the kidney infected unless urine containing pus and bacteria was obtained by ureteral catheterization, whereas evidence of hydronephrosis and stone was obtained from examination of the kidney removed by, or examined at, operation or from pyelographic examination. It was found in the clinical cases that there were 20 ectopic kidneys showing some degree of infection, the 68 remaining did not. In 13 cases there was evidence of hydronephrosis in addition to infection (Fig 9), in 5 cases stones were present as well as infection, and in 2 cases a stone was present, apparently without infection being present (Figs 10, a and b, and 11). Tuberculosis of the ectopic kidney was diagnosed in 2 cases, but there was no reason to think that the renal anomaly contributed in any way toward development of the disease. That an ectopic kidney may be subject to formation of a large tumor is proved by the 1 case in which a large hypernephroma occurred in a kidney situated in the pelvis. There was no evidence in this series of cases that the ectopic kidney is any more liable to



Fig 10 b Retrograde pyelogram showing a stone in the upper group of calyces (see retrograde pyelogram on right)



Fig 11 Left ectopic kidney containing a stone and overlying the sacro iliac joint the stone appears as a filling defect in the renal pelvis

damage in the ordinary course of life than is a normally placed kidney. A possible exception to

this is when pregnancy occurs in a case of ectopic pelvic kidney

#### PREGNANCY AND ECTOPIC PELVIC KIDNEY

From time to time one sees in the literature the statement that a pelvic kidney may be the source of dystocia. Cragin, as early as 1898, reported 5 cases that had been discovered during labor and felt that such a kidney was able to produce extreme dystocia. He suggested that it was an indication for the induction of early labor or for cesarean section.

In this series of 97 cases there were 23 married women with pelvic ectopic kidneys. Two of them had never been pregnant, but of the 21 women who had conceived, 14 had had one or more children without difficulty (Figs 12, a and 12, b), and 5 had had one or more miscarriages with no full term pregnancy. Another woman in the group had a full term pregnancy, which resulted, however, in a dead child as a result of instrumental delivery. The remaining patient who had been pregnant said that her first child had been delivered with instruments, but that the next 2 pregnancies had required cesarean section. It is therefore evident that in the majority of cases labor will progress normally in spite of an ectopic pelvic kidney, and the mere existence of the anomaly does not warrant radical measures either



Fig 12 a Left Left ectopic pelvic kidney showing tendency toward duplication of the renal pelvis this woman had given birth to 4 children labor apparently having been



normal b In this roentgenogram of the right kidney there is shown definite duplication of the pelvis and some elongation



kidney will permit. The only exception is pelvic lithotomy in cases in which there is little or no pregnancy which generally be uneventful and labor normal in spite of an ectopic pelvic kidney.

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## SUMMARY AND CONCLUSIONS

In a series of 97 cases of ectopic kidney the condition was discovered at necropsy in 9 cases, and by physical examination or surgical exploration in the 88 remaining. This is an incidence of about 1 in every 1,200 necropses performed at the Mayo Clinic and represents an incidence of approximately 1 in every 10,000 patients observed clinically.

Because of lack of symptoms which might lead to urologic investigation renal ectopia is often discovered only at the time of surgical exploration, in 8 cases of our series the ectopic kidney was a congenital solitary organ which fact must be carefully weighed if anyone contemplates nephrectomy in cases of renal ectopia without the advantage of pre-operative urographic study.

Twenty-nine, or 32.9 per cent., of our series of 88 patients clinically found to have ectopic kidney suffered from recurrent pain, indicating that the ectopic kidney as a rule drains poorly owing either to its position or to constriction of the ureteropelvic junction by anomalous blood vessels or perirenal tissues.

Treatment, such as ureteral dilatation, may cause harm and generally will not benefit the patient. As a general rule if treatment is indicated, it should be surgical in type. Conservative operations, such as plastic procedures on the renal pelvis or ligation of anomalous vessels, are likely to fail. Nephrectomy is therefore the treatment of choice if the function of the opposite

## SARCOMA OF THE RENAL HILUS

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**S**ARCOMA of the kidney excluding Wilm's tumor or embryonic tumors occurring in children is of such rare occurrence that individual cases when encountered are reported, and sarcoma originating from the renal pelvis or hilus continues to remain a curiosity. Since sarcomas are mesenchymatous in origin they may originate from the renal capsule, the interstitial tissue, the blood vessels of the renal parenchyma, the pelvis, and the renal hilus. The tumors, frequently are of such large size that their origin is very difficult to establish. Boyd states that sarcoma of the kidney always arises in the capsule and secondarily invades the renal parenchyma. Koehler describes a case of liposarcoma originating from the fatty capsule of the upper pole of the kidney.

A variety of sarcomas situated in the parenchyma of the kidney have been described: leiomyosarcoma by Delaney, reticular cell sarcoma by Elmer and Boylan, osteoblastoma by Haining and Poole, fibromyxosarcoma by Nichols, fibrosarcoma associated with stones by Kretschmer (9), etc. In this group, the tumors originated from the interstitial mesenchyma. The existence of primary lymphosarcoma of the kidney is questionable, although the kidney is a favorite site of metastasis. Some writers believe that the renal pelvis may also give rise to sarcoma, and such cases have been reported by Kretschmer and Randolph (8), Watson and Russum, and Lynch and Thompson.

The tissues found in the renal hilus may be the source for a variety of tumors which must be distinguished from tumors of the renal parenchyma, the pelvis, the adrenals, and retroperitoneal tissues. Tumors originating at the renal hilus compress the blood vessels of the kidney, the ureter, and also compress and displace the kidney. De Vecchi and Solomon reported a peculiar form of sarcoma of the renal hilus and pelvic tissue. The tumor was bilateral, occurred in infants under 2 years of age, and encircled the ureter, great vessels, pelvis and papillae but was demarcated from the renal parenchyma. Histologically, the tumor consisted of round cells and spindle cells.

Myxoma and myxosarcoma of the renal hilus produce bulky masses infiltrate the surrounding

tissues, and cause displacement, stretching and atrophy of the kidney (3). Benign tumors of the renal hilus noted are lipoma, myoma and angiolipoma.

Sarcomas originating in the region of the renal hilus are very apt to be mistaken for tumors of the renal pelvis. Upon closer inspection of the gross specimen and from histological studies, it may be noted that in this type of tumor the pelvis is usually not involved, but just compressed and displaced by the tumor mass.

The etiology of sarcoma of the renal hilus is unknown. In the group of sarcomas originating from the parenchyma of the kidney associated with renal stones it is possible that the stones may initiate chronic inflammatory changes with subsequent sarcomatous degeneration.

In a review of 42,450 surgical specimens from July, 1928, to July, 1936, inclusive, 36 malignant tumors of the kidney were encountered.

They are as follows: Fibrosarcoma of the hilus, 2; carcinoma of the pelvis, 2; hypernephroid carcinoma, 30; and Wilm's tumor, 2. Thus the incidence of sarcoma in this group was 5.55 per cent of the malignant tumors of the kidney. During this same period 38 malignant renal tumors were encountered in a series of 8,732 consecutive autopsies at the Cook County Hospital. In this group there was 1 sarcoma, an incidence of 2.6 per cent. The tumor was found in the renal cortex as an incidental finding in a white male, aged 63 years, the cause of death being hypertensive heart disease. Histologically the tumor was a fibrosarcoma.

### CASE REPORTS

**CASE 1:** A white male aged 50 years, entered the medical service of the Cook County Hospital in January, 1935. He had been in good health until 4 years ago when he came short of breath, developed edema of his ankles, and had to be hospitalized for 3 weeks. For the next 3 years he was free of symptoms except for fainting spells which would occur about once a month. Three months prior to his admission shortness of breath occurred associated with orthopnea and swelling of his legs. He stated that for many years he experienced pain in his back without relief. During the past 6 months he had lost 15 pounds in weight. Lately he had developed nocturia, three to four times a night, frequently during the day six to seven times and painful urination.

The past history disclosed that the patient had a tumor removed from the left side of his back in 1932 at another hospital. The nature of this tumor could not be ascertained.

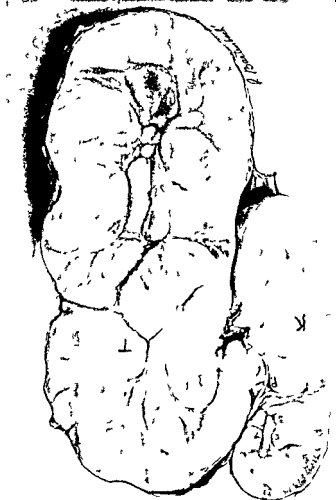


Fig 2 Case 1 Drawing illustrates the tumor of the renal hilus compressing the kidney K, kidney, P, compressed renal pelvis, T, lobulated tumor mass

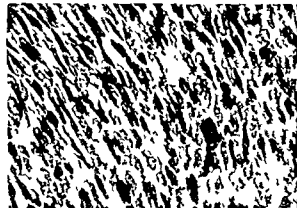
for him to the genito urinary ward for nephrectomy. At operation a well encapsulated tumor mass was found in the right flank with a normal appearing adrenal gland on the upper pole. The kidney appeared intact and was attached to the tumor mass on its lower medial border. Following the operation the patient ran a low grade fever, his pulse was of a poor quality and a seropurulent material freely drained from the wound. He became septic, developed severe chills and went into coma. Urinary de-

veloped and he expired 3 weeks after the nephrectomy. Permission for a necropsy was not given. *Surgical specimen.* The specimen (No 88135) consists of a kidney which is adherent to a large firm mass measuring 22 by 15 by 8 centimeters. The mass fuses with the kidney at the renal hilus and although the renal pelvis is markedly compressed, it can be well identified. The tumor is covered by a smooth, thin, dense fibrous capsule which is firmly adherent to the underlying tissue. The surface is irregularly nodular and light purple gray in color. On sectioning, the surface of the tumor mass is made up of purple gray to purplish white and subdivided into lobules by strands of connective tissue (Fig 2). The tumor completely demarcated from the medulla of the kidney. Loosely adherent to the upper pole of the tumor is the adrenal gland much flattened but otherwise unchanged. The cortex is bright light yellow and the medulla distinct

Fig 1 Case 1 Roentgenogram shows the tumor mass T in the right upper quadrant displacing the pelvis and the superior calyx of the kidney downward



Physical examination revealed a fairly well nourished white male, who appeared dyspneic. His blood pressure was 140 systolic and 70 diastolic. His temperature was 96.6 degrees, pulse 108, and respirations, 28. The lungs disclosed roughened breath sounds. The heart was slightly enlarged to the left, and no murmurs were heard. In the abdomen a large mass was felt in the right upper quadrant which extended down below the umbilicus and occupied the region of the kidney. It was smooth and firm, the edges were rounded, and it moved with respirations. The left kidney was not palpable. There was a pitting edema of both lower extremities. The clinical diagnosis made was organic heart disease with decompensation and the mass in the abdomen was interpreted as a renal tumor. The electrocardiogram was essentially normal. Urinalysis showed 2 plus albumin on several occasions. Blood examination revealed hemoglobin, 80 per cent, red blood cells 4,750,000 and white blood cells 9,500, no abnormal blood cells were noted. The blood Wassermann test was negative. Blood chemistry revealed a urea nitrogen of 35 milligrams and creatinine 2.36 milligrams per 100 cubic centimeters of blood. Examination by Dr. C. H. Warrfield of an anteroposterior roentgenogram showed a homogeneous soft tissue mass in the right upper quadrant. Intravenous injection of hippuran showed good visualization of the pelvis and calyces on the right side. The pelvis and superior minor calyx were displaced and depressed downward and laterally by the previously described tumor mass (Fig 1). The impression was that the tumor mass appeared to originate from the pelvis or superior calyx of the kidney. Roentgenograms of the gastro intestinal tract and chest were negative. The patient promptly improved upon cardiac management and after 3 weeks it was deemed advisable to transfer the patient to the genito urinary ward for nephrectomy. The patient died 3 weeks after the nephrectomy.



Figs 3 and 4 Case 1 Photomicrographs (low and high power) of the tumor

The kidney adjacent to the mass measures 11 by 3 by 3 centimeters. It is firm, the capsule is thin and strips with ease leaving a smooth pale purple gray surface. The cortex measures 4 millimeters in thickness and the renal pelvis for the most part is obscured by the tumor. The superior calyx although markedly compressed can be recognized.

Microscopic examination of sections taken from different sites of the tumor revealed a uniform picture throughout. The tumor was found to be very cellular and composed of sheets and interlacing bundles of spindle shaped cells with elongated and hyperchromatic nuclei (Fig. 3). In places the nuclei were irregular in shape and mitotic figures were frequently seen (Fig. 4). Van Gieson stain revealed a varying amount of stroma composed of loose fibrillar connective tissue. The tumor was seen to bulge into the renal pelvis compressing it but was sharply demarcated from the renal parenchyma by strands of loose fibrillar connective tissue and groups of fat cells (Fig. 5). There was no evidence of any invasion of the kidney proper by the neoplasm.

The normal architecture of the kidney was well preserved. The lumen of the superior major calyx was found compressed by the tumor and was lined by a thickened layer of epithelial cells with early metaplasia into squamous epithelium.

**Diagnosis:** Fibrosarcoma of the hilus of the right kidney.

**CASE 2.** F. W., a colored female aged 45 years entered the gynecological service of the Cook County Hospital because she had noticed a mass progressively growing,

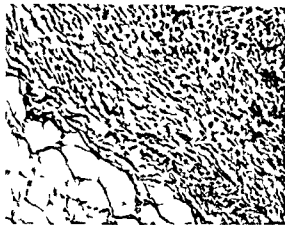


Fig. 5 Case 1 Photomicrograph of the tumor shows the relationship of the tumor to the fat tissue in the region of the renal hilus. Note the spindle cell character of the tumor.

larger in her abdomen for 1 year. Eight months prior to her admission to the hospital pain which was sharp and burning, and felt like a boil developed in the left side. For the last 3 months nocturia had been present three to four times each night associated with frequency and urgency during the day. During the past 3 weeks she had been aware of pain also in her groins and legs of a severe and stabbing character. Her appetite was poor, she was constipated and had lost 17 pounds in weight during the past year. Shortness of breath had been noticeable with moderate exertion.

Her past history was essentially irrelevant. She had rheumatism in 1920, 3 miscarriages, 1 child and had passed through the menopause 7 years prior to admission.

Physical examination revealed a colored female who did not appear acutely ill. Her temperature was 98.6 degrees, pulse 88 and respirations 20. The pupils reacted promptly to light and accommodation. The heart and lungs were essentially negative. The abdomen was found distended and protuberant. Palpation disclosed a large mass on the left side about the size of an 8 months pregnancy. The mass was nodular firm and non fluctuant. Tenderness was noted throughout but especially in the left side near the costal margin and extended to the vertebral spine. The tumor seemed to fill the left quadrant and its lower margin was lost in the pelvis.

Vaginal examination disclosed the uterus to appear continuous with the large mass. The adnexa especially on the left side and the tumor mass were extremely tender. Rectal examination gave no additional information.

The diagnosis considered was inflamed fibroids with possible sarcomatous degeneration, left chronic salpingitis or solid tumor of the ovary.

A laparotomy was performed by Dr. J. P. Greenhill. In the region of the left kidney a large tumor mass was found measuring 16 by 10 by 10 inches which was easily removed. The patient had an uneventful postoperative course and was discharged 15 days later. An attempt was made recently to locate the patient but her whereabouts remain unknown.

**Surgical specimen.** The specimen (No. 117730) received consists of a large irregular nodular mass about the size of a man's head occupying the renal hilus. The nodes are irregularly joined together and in places contain cystic areas. Attached to one aspect of the mass is the markedly de-

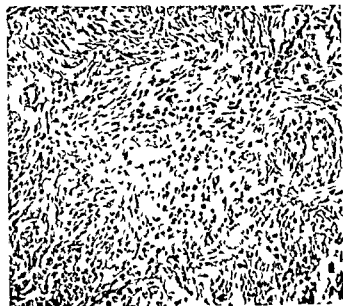


Fig 6 Case 2 Photomicrograph showing the spindle cell character of the tumor with many hyperchromatic regular nuclei



Fig 7 Case 2 Photomicrograph showing nests of epithelial cells with an ample cytoplasm. Note the areas of hyalinization, II, and sarcomatous areas, S

Pneumography is of great diagnostic aid, especially the method employing the retrograde route. The kidney is usually displaced, and the renal pelvis and calyces are compressed and show a filling defect which is the result of pressure of the neoplasm.

The mortality of sarcoma of the hilus of the kidney is extremely high, and this may be due to the fact that these tumors grow very rapidly producing little or no clinical manifestations and when the patients present themselves to the doctor the tumor has already attained an enormous size.

In the first case, except for the lumbar pain, the patient was unaware of the presence of a tumor. His chief complaints were referable to the heart. In the second case, symptoms were present for 1 year before the patient sought medical aid.

In both cases the kidney was found much compressed, showing atrophic changes but no invasion by the neoplasm. Hydronephrosis, which is a common complication due to pressure of the tumor upon the renal pelvis and ureter, was present in the second case only.

In both cases the tumors were very anaplastic and grew very rapidly but no metastasis was evident, either clinically or at operation. Because of their location and their intimate relationship to the kidney, these tumors seemed to have originated from the mesenchyma of the hilus of the kidney. Some of these so called retroperitoneal sarcomas, the starting point of which heretofore has been obscure, may take their origin from the region of the renal hilus.

formed left kidney, stretched out into a thin shell, except on one pole where renal structures are fairly well preserved. The surface of the tumor is mottled purple gray and yellow gray with extensive areas of hemorrhage. In places there are small cysts while in other places areas of fibrosis and calcification are found.

The kidney when sectioned is for the most part transformed into an apple sized cavity, surrounded by a thick fibrous capsule.

Microscopic examination of sections taken from different parts of the tumor revealed chiefly bundles of spindle cells, with irregular, hyperchromatic nuclei. Here and there were seen giant cells (Fig 6). There were numerous areas in which the tumor tissue was necrotic. In the periphery imbedded in dense connective tissue were islands of large clear cells with distinct cell membranes, an ample cytoplasm and small round nuclei (Fig 7). In addition to these areas and nearby were small groups of dark nucleated round and cuboidal cells arranged in coils and columns.

The compressed kidney showed advanced atrophic changes especially of the tubules. Some of the tubules near the pelvis were dilated. The stroma was increased and the arteries were moderately sclerosed. The intact glomeruli showed a widening of Bowman's space and a thickening of the capsule. There was no invasion of the kidney by the tumor mass.

**Diagnosis.** Mixed tumor of the renal hilus with sarcomatous transformation and marked regressive changes in the tumor mass.

Atrophic changes of the renal parenchyma and hydro-nephrosis.

Tumors originating from the region of the renal hilus are practically impossible to diagnose during life, and their true nature is disclosed only at operation or at necropsy. They usually manifest themselves clinically as a rapidly growing tumor mass, which is associated with much pain, the pain frequently being referred to the back. Hematuria is absent until the mucosa of the renal pelvis is invaded by the neoplasm.

## CONCLUSIONS

Two cases of sarcoma originating in the region of the renal hilus are presented a fibrosarcoma and a mixed tumor with sarcomatous elements

The true character of the neoplasm in each instance was not suspected before operation The diagnosis was made from the pathological examination of the excised specimens

Clinically this condition presents vague symptoms, and the diagnosis is usually made very late It may be well to remember that tumors found compressing the kidney may have their origin in the renal hilus, which may help to explain the origin of some of the obscure sarcomas located either in the perirenal or retroperitoneal tissue

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# INTERLOCKING OSTEOPLASTIC CRANIAL FLAP

## A Method to Prevent Lateral Movement

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WHEN the bone flap of the conventional osteoplastic flap is replaced, there is nothing, so far as the shape of the bone is concerned, to prevent lateral movement of the flap. By holding the Gigli saw at an angle it has long been customary to bevel the bone edges so as to prevent the flap from falling in, but nothing has been done to mortise the bone edges so as to prevent lateral movement. By reversing the direction of the Gigli saw half way between the trephine holes, as shown in Figure 1, a mortise notch can easily be made to make the direction of the saw is changed. At the time the direction of the saw is reversed with the saw just before its direction is reversed too suddenly or if the groove is widened a little turn in direction of the saw is made. This can be avoided if the direction of the saw is not changed by the conventional flap without notches. The saw may break unless care is taken to avoid its being pinched by the bone edges as the abrupt turn in direction of the saw is made. The square notch makes for better locking than the pointed. If three or four notches are made in the bone, an interlocking flap which prevents lateral movement results and a better fit is obtained than by the conventional flap without notches. The notch may be made pointed or square. The square notch makes for better locking than the pointed. If three or four notches are made in the bone, an interlocking flap which prevents lateral movement results and a better fit is obtained than by the conventional flap without notches. The saw may break unless care is taken to avoid its being pinched by the bone edges as the abrupt turn in direction of the saw is made. This can be avoided if the direction of the saw is not changed by the conventional flap without notches. The saw may break unless care is taken to avoid its being pinched by the bone edges as the abrupt turn in direction of the saw is made. The square notch makes for better locking than the pointed. If three or four notches are made in the bone, an interlocking flap which prevents lateral movement results and a better fit is obtained than by the conventional flap without notches.

At the time the direction of the saw is changed to make the mortised notch, the saw can be drawn so as to bevel the notch in the plane opposite from that which was used to bevel the rest of the flap.

Figure 1, a mortise notch can easily be made

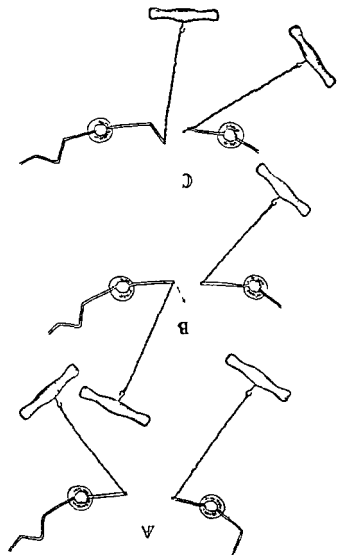


Fig 1 Formation of interlocking mortised notch

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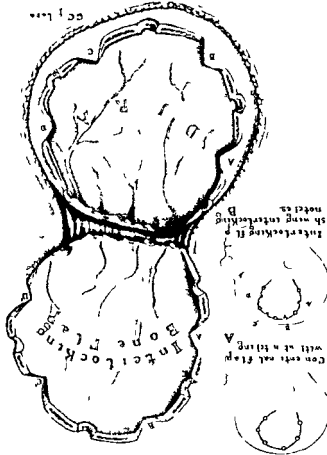


Fig 2 Flap reflected, showing locking notches at A, B, C, D

I have used an interlocking flap made in this manner for a number of years and it has proved highly satisfactory. The procedure is simple and

this type of flap offers sufficient advantages to make it preferable to the ordinary beveled flap without interlocking notches.

## INJURIES OF THE HANDS DUE TO SHATTERED PORCELAIN HANDLES OF WATER FAUCETS

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THE porcelain handles of water faucets, so commonly used in many homes and hotels, are a potential source of serious injury to the hands. This simple fixture does not usually receive attention until some form of injury occurs. The injury may be a mild abrasion of the skin and the immediate subcutaneous tissues, in which case the wound is quickly cleansed with an antiseptic solution and permitted to heal without any further discomfort or it may be a more serious injury, such as a deep laceration of the palm or fingers, in which instance one or more tendons or nerves may be severed.

Two types of porcelain handles are in common use. The first type has a metal core which extends the entire length of the porcelain and is attached to the water faucet by means of a screw inserted through the core. The other type is one in which the porcelain is cemented over a metal core or about a central metal hub with plaster of Paris; the four porcelain arms protrude in the form of a cross (Fig. 1). The latter type is more likely to break than is the former. When force is applied to the porcelain handle, usually in the presence of a leaking faucet, one of the porcelain arms shatters and a jagged edge of porcelain lacerates the hand. This type of injury may be superficial or deep, depending on the degree of force applied to the porcelain.

In the past 5 years we have observed 12 injuries of this type at the clinic (Table I). In 9 cases the injury involved the right hand and in 3 cases it involved the left hand. The nature of the injuries is shown in Figure 2. Five of the patients were treated immediately or soon after the accident had occurred. The remaining 7 patients came to the clinic at a later date because of deformity and

disability of the hands which were the result of infection or were caused by laceration of one or more nerves or tendons.

The surgeon who sees the patient immediately after the accident has the best opportunity to secure a satisfactory result. It is at this time when the structures underlying the injury are relatively in their true anatomic relations, that a clearer vision and approximation of the severed fragments of nerves or tendons may be obtained. After cicatrization has occurred at the site of injury and after the underlying structures have become hopelessly bound together by scar tissue, the surgical treatment and prognosis for complete return of function of the part involved are often unsatisfactory, regardless of the skill of the surgeon.

These injuries may vary greatly in the extent of their severity, depending on the depth of the laceration. The more superficial the laceration, the less is the damage that is done. One must remember that while a small wound of the skin may be present, severe deep injury may occur with involvement of nerves and tendons. Careful examination previous to operation is essential. One should apply a temporary hemostatic dressing and then carefully examine for injury to the tendons or nerves by asking the patient to perform movements of all fingers and by testing sensation over the entire hand. The best possible estimate of injury must be made at this time. One cannot always be certain of the extent of injury, because a tendon occasionally may be severely, but not completely severed. This may give a false impression of the situation. Such a laceration may be overlooked and at a later date the tendon may rupture spontaneously.

When the diagnosis has been made and the extent of injury has been carefully estimated, treatment should be carried out under the best surgical





TABLE I—TYPE OF INJURY AND RESULT OF TREATMENT

CASE	Reason for consultation	Ex- tremity	Extent of the injury	Tendon involved	Nerve injured	Sec- ondary ex- tremity in- jury	Wound sutured at time of injury	Tendons and nerves sutured at time of injury	Proxi- mal graft required	Distal graft required	Result at final month
1	Laceration	Right	Deep	Flexor pollicis longus	Branch of median	No	Yes	Yes	No	No	Good
	Deformity of dis- ability parenthesis	Right	Deep	Flexor digitorum superioris and profundus	Branch of ulnar	Yes	Yes	Yes	No	No	Fair
2	Deformity of dis- ability	Left	Deep	Flexor pollicis longus	None	Yes	Yes	Yes	Yes	Yes	Fair
3	Laceration	Right	Superficial	None	None	No	Yes	No	No	No	Good
	Deformity of dis- ability parenthesis	Right	Deep	Flexor pollicis longus	Branch of median	Yes	Yes	Yes	No	No	?
4	Deformity of dis- ability parenthesis	Right	Deep	Flexor pollicis longus	Branch of median	Yes	Yes	Yes	No	No	Good
	Laceration	Right	Superficial	None	None	Yes	No	No	No	No	Good
5	Deformity of dis- ability	Right	Deep	Flexor digi- torum	None	Yes	Yes	Yes	No	No	?
6	Laceration	Left	Deep	Flexor pollicis longus	Branch of median	Yes	Yes	Yes	No	No	Good
7	Laceration	Right	Deep	Flexor pollicis longus	None	Yes	Yes	Yes	No	No	Fair
	Deformity of dis- ability parenthesis	Right	Deep	Flexor pollicis longus	Branch of median	Yes	Yes	Yes	No	No	?
	Laceration	Left	Superficial	None	None	Yes	Yes	No	No	No	Good

to the involved structures prevents the approximation of the fragments and in cases in which treatment has been delayed marked contraction of the proximal end of the tendon may have occurred. The palmaris longus tendon or sections of the peroneal tendons may be used as grafts. The graft should be carefully measured, fitted in between the severed fragments, and sutured with silk. The wound then should be closed and the hand bandaged.

One cannot stress aseptic technique too much. An infection in one of these injuries usually results in some type of deformity. A large denuded portion of the palm or fingers may require not only tendon grafts, but also a skin graft. Dissection of the underlying fragments which have become buried in the scar tissue as the result of infection is very difficult and the outcome is usually poor even in the most skillful hands.

We have found that the tendon of the flexor pollicis longus muscle is most frequently severed in these cases. The observation is frequently overlooked when the examiner's attention is focused on adduction and abduction of the thumb. Unless all movements of the thumb are tested at the time of the initial injury, the patient may re-

turn several months later because of the inability to flex the distal phalanx of the thumb and finally as in holding a pen.

Next in frequency of occurrence is the injury to one or more tendons of the wrist extensor sublimus muscle. In these injuries the deformity as a result of the severed nerves and tendons is usually recognized at once and the proper type of treatment is instituted.

There may be partial or even complete division of the tissues innervated by the branches of the ulnar and median nerves. The lacerations may extend deep enough to sever one of the larger branches or several of the fine filaments. When a large nerve has been severed primary repair affords better functional results than dissection of scar tissue and secondary repair at a later date. The nerve ends are approximated by means of the finest grade of silk suture material. Here a very fine needle is used and the suture is passed through only the epineurium. Secondary suture is not as satisfactory as the primary approximation because the fibers become lost in the mass of scar tissue. Neuromas at the ends of the filaments are common and must be excised before amputation is performed.

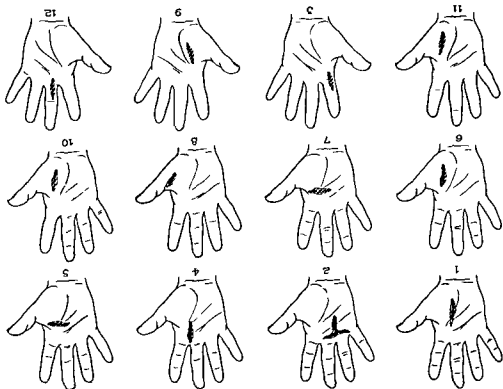


Fig. 2 Site of lacerations in the cases presented in this series

## REPORT OF CASES

**CASE 1** An office manager, aged 44 years, came in immediately to the hospital after he had lacerated the thenar of his right hand on a porcelain handle of a water faucet on June 27, 1930. An emergency operation was performed. There was considerable bleeding. The wound was opened, and it was found that the laceration extended through the deep palmar arch. Accurate hemostasis of the bleeding vessels was accomplished by placing a tourniquet around the arm. It was necessary to extend the incision down over the wrist and split the annular ligament in order to find the proximal end of the severed tendon of the flexor pollicis longus muscle. One branch of the median nerve was sutured and the wound was closed.

A splint was applied. In December, 1935, the patient reported that he has good function in the thumb and that sensation has re-

turned in the index finger.

**CASE 2** A veterinarian, aged 44 years, registered at the clinic on October 15, 1930, complaining of loss of flexion of the distal phalanges of the middle and ring fingers, partial

loss of extension of the little finger and numbness of the little finger and ulnar half of the ring finger of the right hand. On August 17, 1930, he had lacerated the palm of the hand on the jagged edge of the porcelain handle of a water faucet. Severed tendons which had been observed at the time of the injury, had been sutured immediately after the accident. The wound had healed by first intention. Examination at the clinic revealed a transverse scar at the base of the middle, ring, and little fingers, and a longitudinal scar which extended from the metacarpophalangeal junction to the middle of the palm. The patient was unable to flex the distal phalanges of the middle and little fingers or to straighten the ring finger further than an angle of 160 degrees. A neurologic examination disclosed an injury of the cutaneous branches of the ulnar nerve. On October 23, 1930 an incision was made along

the ulnar border of the middle finger. The distal end of the tendon of the flexor digitorum profundus muscle was attached to one of the tendons of the flexor digitorum sublimis tendons and was curled up on itself. The proximal end of the lacerated tendon could not be reached, so another incision was made over the wrist and the annular ligament was divided. The proximal end of the tendon was found in a sheath which was filled largely with a gelatinous material and scar tissue. The ends of the tendon were freed and sutured. When the operation was completed it was noted that the patient could move the distal phalanx of his middle finger without difficulty. It was thought best to repair the tendon of the little finger at a later date because of the time required.

A report which was received from the patient in December 1935, revealed that there has been little, if any improvement.

**CASE 3** A stenographer, aged 27 years, registered at the clinic on February 13, 1931, complaining of stiffness caused by a lacerated wound of the left index finger which had

failed to heal. Four weeks before the patient came to the clinic she had cut her finger on the porcelain handle of a water faucet and a physician had sutured a severed tendon. Examination at the clinic on February 13, 1931, revealed an infection at the base of the left index finger. Warm moist dressings were applied. On February 19, 1931 a small amount of necrotic material was removed from the region at the base of the left index finger, and at that time the proximal end of the tendon of the flexor digitorum profundus muscle could be seen in the wound. The wound was cleaned and active and passive motion of the hand was employed to limber up the fingers. On February 27, 1931, a small crust was seen in the wound, at this time, it was noted that the fingers could be moved more freely. The patient was advised to return to the clinic in 6 weeks.

On March 13, 1931, more necrotic material was removed, and the fingers were manipulated while the patient was

under anesthesia. On April 22 1931 operation revealed considerable scar tissue along the palmar surface of the left index finger. The scar tissue extended over the head of the second metacarpal bone and down to the distal phalanx. The scar tissue was excised. The proximal and distal ends of the tendon of the flexor digitorum profundus muscle were freed from the scar tissue. A section of the tendon of the peroneus longus muscle was removed from the left foot and a piece of fascia lata was removed from the left thigh. The ends of the section of the tendon of the peroneus longus were sutured to the proximal and distal portions of the tendon of the flexor digitorum profundus. The piece of fascia lata was wrapped around the tendon graft. A full thickness graft of skin was used to close the wound. At the completion of the operation the patient was able to flex the index finger. A plaster-of-Paris cast was used to support the fingers.

A report which was received from the patient in December 1935 revealed that the action of the finger has been much improved.

CASE 4. A housewife aged 37 years was brought to the hospital on September 21 1931 complaining of a laceration of the palmar surface of the right hand between the index and middle fingers. The injury had been sustained on the porcelain handle of a water faucet. Examination revealed a superficial laceration of the right palm; the nerves and tendons had not been injured. The wound was thoroughly cleansed, sutured and dressed.

A report which was received from the patient in December 1935 revealed that complete improvement has occurred.

CASE 5. A man aged 22 years who was an officer in the Salvation Army registered at the clinic on May 2 1932 complaining of deformities of the middle and index fingers of the right hand which were associated with numbness of the middle and ring fingers. Four months before he came to the clinic he had cut the palm of his right hand on the porcelain handle of a water faucet immediately after the injury he had been unable to flex the index and middle fingers. The numbness of the middle and ring fingers also had occurred immediately after the injury. Examination at the clinic revealed a healed scar which was  $\frac{3}{4}$  inch (1.9 centimeters) long, and situated in the median line of the palm at  $1\frac{1}{2}$  inches (3.7 centimeters) below the wrist. There was venous stasis over the index and middle fingers and the patient was unable to flex the distal phalanx of the index finger. There was some impairment of sensation over the index finger and thumb. On May 5 1932 operation revealed a division of the median nerve just proximal to the junction of the superficial and deep branches. The nerve was sutured without any great tension of the proximal segments. The proximal and distal portions of the tendon of the flexor digitorum profundus muscle were found attached deep in the palm and adherent to the sheath of the flexor tendon of the second finger. These were loosened and approximated by sutures. A plaster-of-Paris cast was used to support the fingers.

An inquiry was mailed to this patient in December 1935 but no answer has been received.

CASE 6. A school teacher aged 20 years registered at the clinic on October 9 1932 complaining of anesthesia over the palmar surface of the right thumb and loss of flexion of this digit. Three months before the patient came to the clinic she had cut her hand on the porcelain handle of a water faucet. The wound had healed by primary intention. Examination of the right hand revealed a scar  $\frac{1}{2}$  inch (1.27 centimeters) long over the thenar eminence of the left hand. The patient was unable to flex the distal phalanx of the thumb and there was anesthesia over the distribution of the median nerve to the thumb. On Febru-

ary 4 1933 an incision was made along the base of the thenar eminence of the right hand. A branch of the median nerve was found to be severed at its junction with the main trunk. The proximal end of the severed branch was rolled up and adherent to the scar tissue. The severed portion of the nerve included the branches to the thumb and index finger. The ends of the severed nerve were freshened up and sutured. The dissection was carried down beneath the nerve and the distal end of the tendon of the flexor pollicis longus muscle was found without difficulty. An incision was then made above the annular ligament and by manipulation of the tendon under the annular ligament its proximal end was found adherent in the scar. Both ends of the tendon were freshened and sutured. At the completion of the operation it was noted that the patient could flex the distal phalanx of her thumb.

A report which was received from this patient in December 1935 revealed that the action of her thumb has been much improved and that there has been some return of sensation.

CASE 7. A student aged 15 years entered the hospital on July 30 1933 complaining of a laceration on the palm of the right hand which had been sustained on the porcelain handle of a water faucet. Examination revealed a superficial laceration  $\frac{1}{2}$  inch (1.27 centimeters) long on the palm of the right hand. There was no evidence of injury of the nerves or tendons. The wound was cleaned and dressed.

A report which was received from this patient in December 1935 revealed that the wound has healed and that there is no deformity of any kind.

CASE 8. A housewife aged 39 years registered at the clinic on August 25 1933. She came for a general examination and at that time requested advice concerning an old injury to her right thumb. On June 15 1933 she had cut her thumb on the porcelain handle of a water faucet. Examination of the right hand revealed a healed laceration of the palmar surface of the right thumb. The tendon of the flexor pollicis longus muscle was adherent to scar tissue. There was 10 degrees of motion in the distal phalanx of the thumb. Physical therapy was advised.

CASE 9. A salesman aged 34 years entered the hospital on April 5 1934 complaining of a laceration of the palm of his left hand which had been sustained on the porcelain handle of a water faucet. Examination of the hand revealed a laceration  $\frac{1}{2}$  inch (0.64 centimeter) long situated over the thenar eminence of the left hand. A small piece of porcelain was removed from the wound. A careful exploration did not reveal any injury of tendons or nerves. The wound was sutured and dressed. On April 15 1934 the patient was unable to flex his left thumb. At that time it was thought that the tendon of the flexor pollicis longus muscle had been cut or was adherent to scar tissue. On April 23 1934 there was loss of sensation over the palmar surface of the distal phalanx of the thumb. On April 4 1934 an operation was performed. An incision was made along the thenar eminence of the left hand. The subcutaneous tissues were separated and considerable scar tissue was found beneath the wound. This was dissected free and the end of the branch of a nerve was found in the scar tissue. The dissection was extended along the flexor surface of the thumb for  $\frac{1}{2}$  inch (0.64 centimeter) until we found the severed ends of the tendon of the flexor pollicis longus lying free. An incision was made on the flexor surface of the wrist above the annular ligament and extended down to the proximal end of the tendon. The tendon was pulled up and a suture was inserted. A probe was inserted along the tendon sheath under the annular ligament to the first wound and the proximal end of the tendon was passed through the sheath and sutured to the

distal end. The branches of the median nerve could be seen. One large branch to the thumb was intact but a smaller branch had been severed. The severed ends were

report in which was received from this patient in December, 1935, revealed that there has been marked improvement in action and sensation of the thumb.

Case 70. A dentist, aged 45 years, entered the hospital on July 10, 1934, complaining of a deep laceration of the

flexor eminence of the right hand, which had been sustained on October 13, 1933, complaining of a laceration of

the left hand which had been sustained on the porcelain handle of a water faucet. Examination of the left hand

revealed a laceration  $\frac{1}{4}$  inch (1.9 centimeters) long situated over the lateral palmar surface of the third finger. There was no evidence of injury of nerves or tendons.

The wound was cleaned, sutured and dressed. A report which was received from this patient in December, 1935, revealed that the wound has healed completely

and that the patient has had no further trouble with her hand.

was noted that the patient could flex his thumb

A report in which was received from this patient in December, 1935, revealed that approximately 50 per cent of the

function of the thumb has returned.

Case 11. An instructor aged 20 years registered at the

clinic on August 27, 1933, complaining of tingling in the

right index finger and thumb and loss of flexion of the distal

phalanx of the thumb. On March 16, 1933, he had cut the

flexor eminence of his right hand on the porcelain handle

of a water faucet. The laceration had been sutured but an

abscess had developed in the wound. Examination of the

right hand disclosed a thick scar over the flexor eminence

of the right hand with approximately 50 per cent loss of

abduction of the thumb and complete loss of voluntary

over the lateral surface of the index finger and over the

medial surface of the thumb. On November 3, 1935, an

incision was made over the right flexor eminence just

lateral to the scar. The underlying tissues were freed and

one of the branches of the nerve to the thumb was isolated

By deeper dissection it was possible to find the distal end

of the tendon of the flexor pollicis longus muscle, which was

very short. Another incision was made over the palmar

surface of the wrist above the annular ligament and the

proximal fragment of the tendon was found. It was ad-

proximal fragment of the tendon of the palmaris longus muscle

was removed and used as a graft. The proximal end of the

median nerve beneath the transverse carpal ligament was

isolated and the neuroma was removed. The proximal end

was then sutured by accurate end-to-end anastomosis to

the two distal stumps of segments going to the thumb and

under finger. A splint was applied and the hand was kept

in slight flexion.

There was almost complete recovery of function and

marked diminution of anesthesia in May, 1936.

Case 72. A housewife aged 39 years, entered the hos-

pital on October 13, 1933, complaining of a laceration of

the left hand which had been sustained on the porcelain

essential source of serious injury to the hands. The surgeon who sees the patient immediately after the injury has the greatest responsibility and the best opportunity for securing a favorable result. The use of brachial block and general anesthesia has been discussed. The acute injuries of the hand should be carefully cleaned, thoroughly examined, and properly treated so that latent deformity, which may be the result of infection or severed tendons and nerves, can be prevented or at least minimized. The tendon of the flexor pollicis longus muscle and the branches of the median nerve were found to be parts most frequently involved in this type of injury. When the lacerations are extensive it may be necessary to use tendon grafts and skin grafts. Suture of once in cases in which this is delayed, a careful neurologic examination should be made so that secondary suture may be facilitated at the time of exploration. Active movement of the hand and physical therapy should be instituted very early.

# MORTALITY IN SURGICAL DIABETES—CRITERIA AND TECHNIQUE IN EXTREMITY LESIONS

## Five Year Study of 496 Cases

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THE fact that diabetes is more diligently sought after and detected together with the fact that modern insulin therapy has almost completely eliminated death from coma makes it possible for the diabetic patient to live longer and thus to be confronted with all the other pathological conditions common to their age group. Outstanding among such conditions are those requiring surgical treatment. Before the discovery of insulin the diabetic was fortunate if he survived. If his condition became surgically complicated he was in the vast majority of instances doomed. With insulin therapy the surgical risk in the diabetic has been constantly lessened until now under good conditions it should compare favorably with that of the non-diabetic. The staffs of hospitals generally are divided into medical and surgical services and there arises therefore a difficult problem in the adequate management of the diabetic patients. While they are being treated on the surgical service the detailed complicated medical treatment must also be carried out. In the Morrisania City Hospital we found this problem especially pressing since the hospital is located in the Bronx in a community predominately Jewish.

The old method of administering medical care on surgical wards by means of request consultations proved unsatisfactory. The medical follow-up was inadequate; there was a division of responsibility and in all the control of the diabetic was poor. Naturally the result of surgical treatment was not good and this led to hesitation on the part of the surgeon to attempt operative treatment. All of these factors produced a staggering mortality. This fact was noticed the first year the hospital was opened. The statistics for diabetic amputation for the year 1931 were reviewed and it was found that in 6 cases of 7 amputations patients succumbed; a mortality of 85 per cent. These results were in such marked contrast to those from institutions doing special work in this field that it was decided to appoint an internist

to care for the diabetics on the surgical service. Thus an organization was begun to provide medical care for the diabetic undergoing surgical treatment.

### ROUTINE AND ORGANIZATION

A simplified standard routine has been instituted. Standard diets which can be readily ordered by number from the diet kitchen have been established. These diets are arranged in different forms—fluid, concentrated, meat free or regular—and in number as to the amount of the diet. This made for ease in changing the amount of the diet by changing the order of a number. Also the form of the diet can be easily changed to suit the condition of the patient but the amount is not changed so that control of the diabetes is maintained. The diets are moderately high in carbohydrates, the protein requirement is met and the fat content is kept low. Twenty-four hour urinalyses are done as routine measures. Insulin is ordered only by the internist. The more urgent diabetic conditions are treated by means of the usual methods of giving by mouth orange juice or other suitable, readily available carbohydrates together with adequate insulin and more frequent urinalyses. In the still more desperate cases glucose infusions and insulin treatments are given and a specimen of urine is taken by catheter for analysis. All patients are seen by the internist, and he alone takes full charge of the medical treatment. His advice is also sought as to the necessity for operation, the time of operation and when the lower extremity is involved his opinion as to the level of amputation or local incision. This seemed best as at first the operative work was done by the attending surgeon in rotation.

The post-operative care of the diabetic patient was also fairly well standardized. On return from the operating room all patients received infusions of 1 liter of normal saline with .5 or .30 grams of glucose, with or without insulin as indicated. The management of carbohydrate metabolism in the period following operation varied according to the surgical indications; infusion and

From the Surgical Services of the Morrisania City Hospital.  
Read before the Surgical Section of the New York Academy of Medicine at a joint meeting with the New York Diabetes Association, May 1, 1935.

TABLE I—MORTALITY OF ALL CASES—  
OPERATIVE AND NON-OPERATIVE COMBINED

Period	First year	Second year	Third period	Fourth period
First period	49	18	37	
Total Deaths	50	15	30	13
First year	145	19	17	19
Second year	107	18	27	145
Third period	25	5	10	8
Fourth period	11	7	54	21
Total Deaths	24	10	41	
Percentage				

TABLE III—MORTALITY OF TOTAL OPERATIVE CASES—ALL LESIONS COMBINED

Period	Total Deaths	Percentage
First period	16	50
Second period	10	34
First year	64	26
Second year	44	25
Third period	13	20
Fourth period	65	20

beds to a ward, with an average occupancy of 35 to 40 patients cared for by 3 or 4 nurses in the daytime and 1 at night.

[illegible]

The present surgical regimen in these cases came about because of the great predominance of lower extremity complications over all other conditions, 222 of 696 cases. Since the method has been followed there has been a reduction in mortality from 37 per cent to 13 per cent in all cases both operative and non operative (Table I). In the total cases without operation all lesions combined, there was a reduction in mortality from 41 to 11 per cent (Table II). These figures include in the hospital until death, the patients who left the hospital at their own request are not included in the total cases with operation, all lesions combined, there was a reduction in mortality from 50 to 20 per cent (See Table III). In all lesions other than of the lower extremities, operative and non operative combined, there was a reduction of mortality from 28 to 10 per

As to the surgical organization, at first each surgeon operated in rotation. This system was followed for the 2 years, 1932 and 1933. Then 3 men were appointed to do the diabetic amputation operations and this system was practiced during the year 1934. In 1935 one surgeon did all the diabetic amputations. All surgical conditions other than those involving the lower extremities were cared for in rotation by the respective surgeons or specialty surgeons. The house staff was the usual one a junior intern to each ward and a house surgeon for each service.

## RESULTS

In evaluating the results after 4 years with the routine stated we must bear in mind the type of patient admitted, control, and the facilities available for care. No patient can be refused admission. Patients are received who may have had private care, but when confronted with a bad prognosis are referred to the city hospital. Similarly patients are transferred to us from other institutions or are sent to us when they are denied admission to other hospitals. As to the legal control of the patient, no patient can be discharged even though he refuses operation, he can leave only at his own request. Once a case has been considered operative the policy has been followed in all instances to operate whenever consent is obtained, we have been fully cognizant of the fact that in many cases in which there has been delay in obtaining consent the prognosis has been very materially altered. The facilities for care are similar to those of any city hospital ward, 30

TABLE IV—MORTALITY IN ALL LESIONS OTHER THAN LOWER EXTREMITIES—OPERATIVE AND NON OPERATIVE COMBINED

	Total	Deaths	Percentage
First period	28	8	28
Second period			
First year	26	7	27
Second year	84	10	12
Third year	53	9	17
Fourth year	81	8	10

TABLE V—MORTALITY IN THE TOTAL LOWER EXTREMITY LESIONS—OPERATIVE AND NON OPERATIVE COMBINED

	Total	Deaths	Percentage
First period	21	10	48
Second period			
First year	24	9	35
Second year	61	17	28
Third period	54	10	18
Fourth period	64	12	19

TABLE VI—MORTALITY IN LOWER EXTREMITY LESIONS WITHOUT OPERATION

	Total	Deaths	Percentage
First period	9	3	33
Second period			
First year	8	2	25
Second year	34	4	12
Third period	23	5	18
Fourth period	28	3	11

cent. These cases include almost every surgical condition met on a general surgical service. They are grouped together, for there is not a sufficient number of each surgical complication to make special studies. In these cases, the surgeons continued to rotate; thus there are only two periods of treatment (Table IV).

In the total lower extremity lesions, operative and non operative combined, the mortality was reduced from 48 to 19 per cent (Table V).

In the lower extremity lesion cases in which patients were treated without operation there was a reduction in mortality from 33 to 11 per cent. These figures do not include the patients who left the hospital at their own request. There are included, however, those cases in which patients refused operation and remained in the hospital until death (Table VI).

The accompanying chart gives a comparison of the mortality in lower extremity lesions operated upon and the surgical procedures followed. The ordinates indicate the operation performed, the minor procedures are the first half, and the major amputations are the second. Each vertical in the abscissæ represents a single case. In charting the procedures on each case the key at the bottom was followed.

TABLE VII—AGE AND SEX INCIDENCE AND MORTALITY (PERCENTAGE) IN SURGICALLY TREATED DIABETIC LESIONS OF THE LOWER EXTREMITY\*

Decades	Females			Males			Total		
	Cases	Death	Per cent	Cases	Death	Per cent	Cases	Death	Per cent
4	3	1	33	0	0	0	3	1	33
5	14	3	23	2	0	0	16	3	19
6	16	3	19	18	8	44	34	11	32
7	10	4	40	12	3	25	22	7	27
8	8	3	37	6	4	66	14	7	50
Total	51	14	26	38	15	40	89	29	31

Cases in the first period of treatment not included

In the first period—when treatment was administered by rotating surgeons and by medical consultants on request—there was a total of 8 cases, with 1 cure and 7 deaths. The cure was in a case of knee amputation with subsequent bone revision. In the major surgery group there was 1 cure. Of the 7 deaths, 1 followed incision and drainage while 6 followed primary mid thigh amputation.

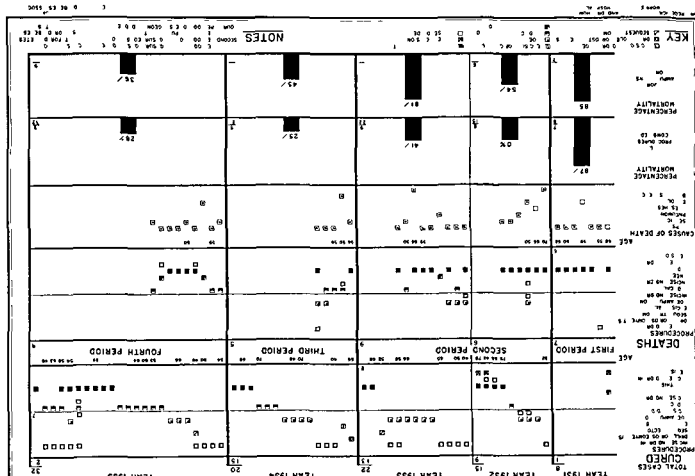
The percentage mortality for the first period, all procedures combined, was 87 per cent, while in the major amputation group the mortality was 85 per cent.

In the first year of the second period, of a total of 15 cases, 9 patients were cured and 6 died. Of the 9 cured, 4 had been subjected to minor surgery, and 5 to major operations. Of the 6 deaths, 5 were after primary mid thigh amputation, and 1 was after secondary amputation. The percentage mortality for this first year of the second period was, for all procedures combined, 40 per cent, and for major amputations, only 54 per cent.

In the second year of the second period of treatment, of a total of 22 cases, 13 patients were cured and 9 died. Of the 13 cured, 11 had been subjected to minor surgery and 2 to major surgery. Of the 9 deaths, all major surgery cases, 5 followed primary amputations and 4 other procedures. The percentage mortality, all procedures combined, for the second year of the second period was 41 per cent. This was about the same as for the first year of that period, and both were marked improvement over the 87 per cent of the first period. For major amputations only, the percentage mortality for the second year of the second period was 81 per cent. This was decidedly greater than for the first year of the second period, it was almost the same as the 85 per cent for the



## MORTALITY IN SURGICAL DIABETES

FIVE-YEAR STUDY 1931-1935  
OPERATIVE PROCEDURES A COMPARATIVE STUDY

first period. This rise in mortality for this group prompted the staff to appoint a team to do amputations in cases with diabetic lower extremity involvement.

In the third period, of a total of 20 cases, 15

patients were cured and 5 died. Of the 15 cured, 6 followed major surgery, with none requiring more than one operation, and 9 followed minor surgery with none requiring more than one operation. All 5 patients who died had been subjected to major surgery, 3 primary amputations and 2 secondary. The percentage mortality for the third period for all procedures combined, was 25 per cent, for major amputations only, 45 per cent.

With this improvement in mortality, one surgeon volunteered to do all the amputations for the next year, which was the fourth period. In this fourth period, of a total of 32 cases, 23 patients were cured and 9 died. Of the 23 cured, 7 had had minor surgery with none requiring more than one operation, and 16 had had major surgery, with 11 primary and 5 secondary great operations.

During the third period, that is the period during which the surgical treatment of lesions of the extremities was being carried on by an amputee team, it was recognized that, if improved

TABLE VIII—CLASSIFICATION OF LESIONS OF LOWER EXTREMITIES IN DIABETES

A Infectious	
1	No clinical evidence of circulatory impairment
2	Lesion primarily infectious.
3	No gangrene
4	Four plus infectious
B Vascular	
1	Marked clinical evidence of circulatory impairment
2	Lesion primarily gangrenous
3	No infection
4	Four plus vascular
C Mixed	
1	Mixed one plus vascular
a	Slight clinical evidence of circulatory impairment
b	Lesion primarily infectious
c	No gangrene
d	One plus vascular mixed
2	Mixed two plus vascular
a	Moderate clinical evidence of circulatory impairment
b	Lesion primarily infectious
c	Gangrene superimposed
d	Two plus vascular mixed
3	Mixed three plus vascular
a	Marked evidence of circulatory impairment
b	Lesion primarily gangrenous
c	Infection superimposed
d	Three plus vascular mixed

results were to be obtained, certain principles not necessarily applicable to surgical procedures in other diseases of the extremity would have to be followed. With the diabetes under control other factors presented themselves which had to be considered to improve the results. The surgical treatment of lower extremity lesions was of primary importance. Great strides have been made in the surgery of these lesions by others (3, 4, 5, 7, 8), and we believed that we also could improve our results by the intensified study of the problem. During the fourth period we attempted to fit our criteria and procedures to the problems peculiar to the surgical diabetic. It may be stated that our ultimate decision as to the state of the extremity lesion and what type of treatment should be used, depends entirely on clinical observation and examination. No oscilometer or dermaterm is used. Histamine or other similar tests are not made and arteriography is not considered necessary. We believe that the same results are to be obtained by means of careful and detailed clinical methods. As to the local vascular status of the limb it was found that not infrequently patients over 60 years of age have extremities with vascular supply good enough to warrant further conservative surgery and conversely, younger patients are encountered who have avascular extremities which require thigh amputation.

## CLASSIFICATION

We have classified diabetic lesions of the extremities as (1) purely vascular, (2) purely infectious, (3) mixed (Table VIII).

**Vascular lesions.** The following factors are the means by which we determine the classification clinically.

1 As to the general condition, the most important factors to study in the history of the patients are age, associated diseases, type and duration of the lesions, and electrocardiographic changes. Local vascular status is determined by clinical findings, such as—

2 The presence of pain, its location, duration and type. The pain may be of the intermittent claudication type which comes on after walking or the night pain of arteriosclerotic feet which is relieved when patient is up and about during the day. It may be the throbbing pain of infection or bone lesion, it may be the pain of arthritis, gout, or arch disturbances. Each type has its characteristics and must be differentiated.

3 The condition of the nails, which may be gnarled and twisted, or of the 'oyster shell' laminated type characteristic of poor circulation. The condition of the skin, its elasticity, dryness, sheen, and tone, all are indicative of the trophic state.

4 The loss of subcutaneous fat and the amount of muscle atrophy.

5 The filling response of the superficial veins to elevation and dependency of the limb. This can be estimated by the rate at which the veins refill on lowering the leg suddenly from a 30 or 60 degree angle to the horizontal.

6 Color changes on dependency and elevation of the limb. When the foot is dependent the degree of extension of rubor or lividity onto the metatarsal area and the depth of the color vary with circulatory status.

7 The level of temperature change as determined by manual palpation.

8 Pulsations of the dorsalis pedis, posterior tibial, popliteal, and femoral vessels and also the condition of their walls. Pulsation in the foot may vary. One or the other (posterior tibial or dorsalis pedis) is often absent and they may be intermittently present. When only one is found pulsating, we may often see in lower leg amputations our clinical estimation of these vessels graphically illustrated by the avascular condition of the muscles formerly supplied by the non pulsating artery.

9 Capillary circulation, as determined by response to finger pressure on the skin of the foot at different levels. This is a minor observation.

the rate of return to the original color is determined after pallor is produced by pressure to Roentgenograms of the limb for vessel and bone changes. These are often deceiving as to vascular status because the shadows cast are calcific deposits in the wall of the vessel, hence the patency of the lumen is not indicated.

These ten items constitute our method of determining clinically the vascular state of the limb and the general condition of the patient.

*Infectious lesions.* The status of the infectious lesions is determined by

1 General condition of the patient, temperature curve and evidence of considerable toxemia indicate an emergency status which makes immediate radical surgery imperative.

2 Locally, the extent of redness, swelling, temperature, fluctuation, discharge, and the presence of lymphangitis and mural and femoral adenitis. The last named is an indication of portance because its presence is an indication of the extent of the infection throughout the extremity.

3 Character and extent of gangrene, if present

4 The type of organism found by smear and culture of local lesions. The presence of hemolytic streptococcus as to outcome should be especially guarded when this type of organism is obtained.

5 Blood culture. The significance of bacteremia and septicemia is, of course, evident.

6 Presence of osteomyelitis either clinically or by roentgen ray.

7 The response of the local lesion to 24 hour wet dressings in cases in which operation is not immediately urgent.

These 7 items constitute the clinical factors studied in determining the status of the infection of the limb.

*Mixed lesions.* Mixed lesions consist of varying combinations of the vascular and infectious types. It is easily understandable that in a leg with fairly good vascularity in which ordinarily amputation below the knee might be the operation of choice, amputation above the knee will have to be performed if fairly severe and extensive infection with sepsis is present.

OPERATIVE PROCEDURES

We have come to the conclusion that only four operative procedures are feasible in the surgical treatment of diabetic limbs. This decision does not apply to surgery of the extremities in the presence of other diseases, vascular or otherwise, because only in the diabetic are present the combination of factors.

1 To avoid carrying in any possible infection from the skin, the electric knife is used on the skin and fascia and occasionally on the muscles. To avoid injury to collateral vessels, which as a rule come off at right angles to the main vessels, section of skin and muscles is done at right angles to the long axis of the limb.

2 Separation of skin, fascia, and muscle planes is never done.

3 Main vessels are ligated at the lowest possible level. Preferably they are cut off at the muscle level. They are not pulled down but are ligated *en masse* with suture ligature of catgut.

4 All small bleeders and vessels are closed by electrocoagulation.

5 The ends of the bones are treated in no way except that in call amputations the crest of the tibia is rounded off with a rongeur.

7 In separating muscles from the bone so that the bone may be sectioned at a higher level,

With these fundamental principles firmly fixed in mind as our ultimate goal, I shall briefly enumerate the steps we use to attain this end. We make no claim as to originality, we have simply made use of the various known measures and facts in formulating our method.

*Skin preparation.* When possible the skin is prepared 48 hours before operation. The preparation consists in shaving and scrubbing the extremity with green soap, washing off with alcohol and wrapping the member in sterile towels. This procedure is repeated the day before the patient is taken to the operating room. The gangrenous or infected foot is wrapped separately and is not unwrapped in the operating room.

*Operative technique.* The method described applies to all procedures.

1 To prevent injury to sclerotic vessels and collateral circulation, a tourniquet is never used. The vessels of diabetic extremities rarely bleed dangerously.

2 To avoid carrying in any possible infection from the skin, the electric knife is used on the skin and fascia and occasionally on the muscles. To avoid injury to collateral vessels, which as a rule come off at right angles to the main vessels, section of skin and muscles is done at right angles to the long axis of the limb.

3 Separation of skin, fascia, and muscle planes is never done.

4 Main vessels are ligated at the lowest possible level. Preferably they are cut off at the muscle level. They are not pulled down but are ligated *en masse* with suture ligature of catgut.

5 All small bleeders and vessels are closed by electrocoagulation.

6 The ends of the bones are treated in no way except that in call amputations the crest of the tibia is rounded off with a rongeur.

7 In separating muscles from the bone so that the bone may be sectioned at a higher level,

special care is taken to avoid cutting vessels, which lie close to the bone, and the small branches

8 Nerves are pulled down, ligated, injected with alcohol, and cut

9 The wound is copiously flushed with hot saline

10 The skin wound is closed with one silk retention suture inserted only through the skin. Skin clips complete the closure. No tension is permitted anywhere in the wound. Muscles are not sutured

11 An alcohol gauze dressing is applied to the suture line with several layers of fluff gauze over this

12 In so far as possible the Lane technique is followed throughout the operation

13 In infected cases, one suture is applied to the skin only and a rubber tissue drain, to which is tied a piece of silk with long ends, is placed in the wound after the method described by Dr Beverly C Smith

These steps are used in all major operative procedures

For amputation below the knee we feel that the modified guillotine amputation advocated by Dr Beverly C Smith is ideal and fulfills the requirements named. We have slightly modified his technique in that a straight guillotine of soft parts is done first and the bones are then resected at a higher level. In amputation above the knee, we use a modified form of the guillotine amputation—a procedure similar to the *en saucisson* method of the French writers advocated by a number of men (3, 4, 5, 7, 8). This is a step operation—the muscles are cut at the level of retraction of skin and fascia and the bone is cut at a higher level, the incisions are all at right angles to the long axis of the limb

**Postoperative treatment** The postoperative dressing is done by the operator, strictest asepsis and care being observed. If the case is clean and the temperature remains normal the dressing is not taken down for 10 days. In infected cases in which the temperature remains around normal the drain is withdrawn after 2 or 3 days, by means of silk string tied to it, but the dressing is not disturbed. In 4 or 5 days or perhaps a week after the drain has been withdrawn if there is still no rise in temperature secondary wound closure of skin only is done with clips

**Consideration of prosthesis** As to the application of future prosthesis we believe that this is of minor importance as compared with the saving of life after so difficult a procedure. Prostheses are so manufactured today that we need not be so concerned as formerly in securing an end

weight bearing stump, for prostheses are now made so that both side weight bearing and ischial weight bearing can be utilized successfully. (2) Whenever possible amputation below the knee is desirable (1) to preserve the knee joint. Even if only a very short section of tibia can be saved a knee weight bearing prosthesis or one crutch with padded knee support can be used

A study of age and sex incidence and the mortality percentage in the surgical treatment of diabetic lower extremity (Table VII) showed the following

These lesions occur at an earlier age in females than in males. This may be due to foot fashions. The mortality is generally higher in males than in females. In both sexes the mortality is higher in the early and late decades than in the middle decades. This may be due to the fact that infection plays a big part in early life and that complications due to generalized arterial disease are responsible in the late decades

#### SUMMARY

The organization of a service for the care of the diabetic requiring surgery resulted in

1 A decrease in the mortality of all surgical diabetic cases

2 A decrease in the operative mortality in all cases

3 A decrease in the non operative mortality in all cases

4 A decrease in the mortality of the diabetic cases requiring surgery other than of the lower extremities

5 A decrease in the mortality of the cases of lower extremity lesions not operated upon

Close co-operation between the internist and the surgeon resulted in

1 A decrease in the total mortality, most marked in the cases involving the lower extremity

2 An increase in the number of cases with involvement of lower extremity in which minor surgery could be done with good results

3 A decrease in mortality especially when major amputations were necessary

#### CONCLUSIONS

The organization of a service for the care of the diabetic requiring surgery and the close co-operation between the internist and the surgeon are essential for good results in these cases

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# EDITORIALS

## SURGERY Gynecology and Obstetrics

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MAY, 1937

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## INTERNATIONALISM IN MEDICINE

**O**N qualifying as a medical practitioner every medical student accepts as a part of the Oath of Hippocrates the statement that he will impart a knowledge of the art to any of his own sons and the disciples bound by a stipulation and oath according to the Law of Medicine. This willingness to impart all new knowledge has always formed one of the ideals of scientific medicine which even in its early days differed from witch and tribal medicine, which were essentially secret. In the gradual progress to modern conditions there have, it is true, been lapses from this ideal so that even surgeons and physicians of repute were known in the past to have fallen victims to the spirit of commercialism and for their own personal gain have kept secret the details of technique in their treatment but, in spite of the fact that the public has always welcomed the quack and has regarded secret knowledge,

whether by manual treatment or the sale of patent medicines, as possessing some hidden virtue unknown to qualified doctors, the more noble spirit of the general diffusion of scientific knowledge has gradually grown until today medicine stands in a position curiously alone, in that the physician or surgeon having to make a living by his own efforts and knowledge increases competition against himself by publishing abroad his methods and thus lessens his source of income. The honest surgeon should even go further and should constantly aim by his investigations of preventative medicine to abolish the very operations by which he makes his living. It is to these two factors, the free diffusion of knowledge and research, that the progress of medicine is due and it is in these two characteristics that medicine stands in advance of other sciences. Every surgeon and every physician has had ingrained in him the need of acquiring knowledge from others at first hand and the pleasure and joy that is to be obtained by freely disseminating his own knowledge. In this comradeship of learning there is no national boundary. Even one hundred years ago medical men traveled widely to other countries to improve their knowledge and were always welcomed and given every opportunity of learning foreign methods. Indeed their opportunities were exceptional for even up to forty or fifty years ago there was still a tendency among well known leaders of medicine to evince some hesitation in training those in their immediate neighborhood to become their competitors.

With increased ease of traveling and greater accessibility this international friendship has progressed to a remarkable degree and it can

now be truly said that medicine knows no boundary and recognizes no nationality. Young men are encouraged in every way to travel and to study abroad. In this respect the United States of America has led the way. Its universities and seats of learning have large numbers of traveling scholars which enable its best and keenest students to study in every civilized capital. The value of such a custom is not only to the student. Every surgeon knows the value of a teaching post and realizes that his own enthusiasm and keenness is kept from flagging by being surrounded by enthusiastic and intelligent young men with whom he has an opportunity of comparing his own observations with those that have been acquired elsewhere.

In theory a subject can be best grasped by careful perusal of a written article but in a busy man's day such perusal is likely to become superficial and thus it happens that more can be gained by taking a short holiday and personally seeing and hearing the author at work. The tired mind is rested, attention is concentrated, and there is freedom from constant interruption. So well is this recognized that there has been of late years an enormous growth of traveling clubs for the most part formed of young surgeons who travel from place to place to see well known teachers at work. Here also as much is gained by those teaching as by the visitors. To a busy surgeon in a teaching hospital a long operating list is not a weary and tiring experience but is an inspiration and a tonic. Keen onlookers are there from every part of the world with whom he can discuss notes and compare methods of treatment. His attention is kept alive and his enthusiasm stimulated by the presence of an appreciative but critical audience. He must feel that he is under close observation and is on his mettle to produce his best. Lasting friendships between surgeons

of widely separated countries have often had their foundations in such meetings and for this reason every surgeon is ready to welcome visitors, and he in turn knows that without question he can travel to any country of the world and whatever may be the political feeling between his own nation and that visited, he is sure of a warm welcome from the surgeons he meets. Probably because of the greatly increased ease of travel this spirit is spreading to all medical societies, associations and clubs so that several times a year every large society has a subject introduced or discussed by one or more famous men from some foreign country and even the great barrier of language is broken down. In this latter respect the English-speaking nations are behind-hand. They are at present generally speaking poor linguists and whereas surgeons from the Latin, Teutonic, and Scandinavian races can usually speak fluent English, men of the English-speaking races have to make their remarks in their own language. The spirit of comradeship has spread to the big representative bodies and colleges. At its inception the American College of Surgeons worked in fraternal relationship with the Royal College of Surgeons of England and now this latter body has followed the lead of the American College in insisting that all candidates for its Fellowship must have served an appointment in a recognized hospital. Of late similar cordial and close relationships are being established between the Royal College of Surgeons of England and the Société Nationale de Chirurgie de Paris.

As a result of these close and friendly relationships there are no longer French, German, Italian, Scandinavian, Russian, English, or American surgeons widely separated by national interests and jealousies, but there is a great brotherhood of medicine consisting of teams working in healthy and friendly rivalry,

not keeping their improvements as jealously guarded secrets but anxious to impart them to other teams. If they are accepted as improvements the reward is sufficient. It has thus come about that in civil medicine the standard of work throughout the civilized world has been raised and the actual standard of any one center of teaching or work is dependent only upon its age and upon the funds at its disposal and not upon its nationality. As a general rule the newest center wherever situated is the best for it has the whole civilized world from which to draw its lesson.

Although so much has been achieved the work is not yet finished. Much may yet be gained by a freer exchange of workers from different medical centers. A first step in this direction has already been instituted and some of the more brilliant young men have been interchanged between American and English centers for a period of some months or a year. Lach carries with him the ideals of his Alma Mater and receives in return the methods and knowledge of his hosts. It is by the growth of such methods that the final barrier will be broken down. In its completed form one would hope to see famous teachers and leaders of medicine travel to centers remote from their own for considerable periods and although at present such a step is only an ideal owing to the necessity of these men earning their livings, still it may even now be more extended and in the future should be capable of a much wider application.

Apart altogether from these benefits to medicine this growth of internationalism has an even greater mission. To every thinking man the futility and absurdity of war is so manifest that it is difficult to realize that this is not universally appreciated. The survival of fit individuals or nations is no longer dependent upon war but upon personal en-

deavor and the finest and most valuable types may be found in any nationality. It has taken 2,300 years for the teachings of Hippocrates to have been widely accepted by medicine, but they have made greater progress in this profession than in any other. By its example it must aim at teaching the civilized world the value of internationalism and strive to remove the bar of language and to establish the true Christian Communism in which all men, whatever their race or creed, have equality of opportunity and each man has a fair reward for his labor. With nations as with men "the greatest of heroes is he who turneth an enemy into a friend."

SIR JAMES WALTON

## THE SURGEON'S INTEREST IN A NEW WORLD

WHEN Pasteur carried to completion his long and brilliant sequence of experiments and deductions, a new realm of nature, that of the universe of microscopic life, stood revealed. What this great discovery has meant to agriculture, industry, sanitation, public health, and medicine can scarcely be exaggerated. What it has meant to surgery in particular is known to all. It forms the very base and foundation of modern surgery. It now appears that we are in the stage of discovery and exploration of another new world, the world of the sub microscopic entities that may affect the health and activities of all living things, plant and animal. These entities are called the alterable viruses. As yet, this field of research is scarcely three decades old and there is much still unknown. It is not even clear that the term "virus" as now used applies to living things, to non living chemical compounds, or to both, spanning the unsurveyed border zone between the animate and



the mammary Of the existence and some of the effects of these entities called viruses there remains no doubt, however

It behooves the surgeon to spare some time from his busy daily affairs to think how this

new field of investigation may soon affect those affairs It is already known that certain

viruses produced diseases have surgical aspects The disease now known as lymphopatia ven-

era causes the indolent suppurative bubo that gave it its earlier name of lymphogranu-

loma inguinale It probably also causes the great majority of non-traumatic fibrous strictures of the rectum Since 1910 the relation of

filterable virus to tumor formation has been an active subject of investigation and contro-

versy, following the discovery of Rous that a certain form of chicken "sarcoma" was trans-

missible by the cell filtrate of the tumor Rous and his colleagues have recently widened

and intensified general interest in this most important question by their work on another

tumor, this time in a mammal They have shown that certain skin papillomas, occurring

as an endemic skin disease in wild western cottontail rabbits, may be transmitted by fil-

trate, and presumably by virus, to the domestic rabbits of the laboratory But the greatest

interest attaches to their further discovery that the papillomas thus transmitted may be-

come definitely and unquestionably carcinomatous This work is still being actively carried forward, and the time has not yet come when conclusions or generalizations are in order The possible great significance of it cannot, however, be mistaken A host of other diseases of man, the animals, and plants are now either proved to be of virus origin, or strongly suspected of having such origin, or come under the classification of possible virus diseases

The surgeon must try to keep abreast of the general advances made in this new world of nature He may find that new therapeutic agencies will be required to deal with whole categories of diseases that are now being dealt with by unsatisfactory methods This may mean the learning of new techniques and the introduction of novel instrumentalities of treatment It will almost certainly mean a new or modified conception of the common terms "infection," "transmission," "contagion" It may add to the field of practical surgery whole new categories of disease, or remove from it some that are now regarded as exclusively surgical It may affect deeply our general biological and philosophical thinking It may alter our conceptions of "living" and "non-living" and of the evolution of life on this planet

HARVEY B. STONE

# MASTER SURGEONS OF AMERICA

## IRVING HEWARD CAMERON

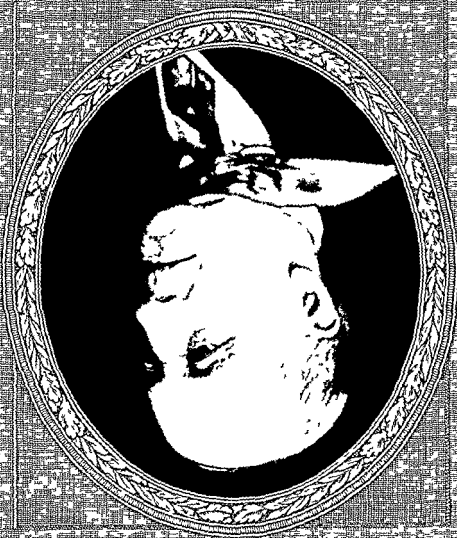
IRVING HEWARD CAMERON, emeritus professor of surgery in the University of Toronto, died at his home on December 15, 1933, after a long illness in his seventy ninth year. In his death we have lost one who with rare qualities of mind and heart, had adorned the profession of medicine for well nigh half a century.

Mr. Cameron<sup>1</sup> was born in Toronto, the son of Sir Matthew Crooks Cameron, Chief Justice of the Common Pleas of the Province of Ontario. He was educated at Upper Canada College and the University of Toronto. Beginning undergraduate study as a student of law, he transferred to the course in medicine, obtaining his Bachelor's degree in 1874. Early in his career he participated actively in university affairs. As a member of the Senate he played an important and effective part in bringing about the reorganization of the Faculty of Medicine in the University of Toronto in 1887. In that year he became professor of the principles of surgery and of surgical pathology on the new staff. In August, 1892, he was appointed professor of clinical surgery, and in 1897 he succeeded the late Dr. W. T. Aikin in the chair of surgery and clinical surgery. He retired in 1920 with the rank of emeritus professor. Mr. Cameron was a loyal son of his Alma Mater and served her interests with unswerving devotion, often at great personal sacrifice. A consultation had to be arranged or cancelled if it interfered with a meeting of a committee of the Senate of which he happened to be a member. The same spirit influenced and controlled his activities in the hospital and the clinic. He played a leading part in the development of many projects relating to the university. He was one of the founders of the Alumni Association and at one time its president. He was among those who established the *University of Toronto Monthly*, and for a number of years was chairman of the editorial board. He was prominent in initiating the movement that led to the erection of Convocation Hall and in the organization of the Faculty Union.

In connection with the Toronto General Hospital and the Hospital for Sick Children he rendered untiring service as surgeon. His influence was great in securing adequate provision for the teaching of medical students in these hospitals. For a time early in his career, he was on the staff of St. Michael's Hospital, and for many years was a leading surgeon in the St. John's Hospital for Women, operated by the Sisters of St. John the Divine on Major Street. In a

<sup>1</sup>He preferred to be called "Mister" rather than "Doctor" following the British precedent for surgeons in that regard.

IRVING H CAMERON  
1854-1933





broadest field Mr Cameron exercised an important influence. He was one of the founders of the *Canadian Journal of Medical Sciences*, past president of the Canadian Medical Association (president in 1908), and of the Toronto branch of the British Medical Association, a member of many societies, including the Société Internationale de Chirurgie and the British Association for the Advancement of Science. He was the author of numerous papers, addresses, and reviews. During the Great War Mr Cameron rendered conspicuous service in organizing the surgical department of the Ontario Hospital for wounded soldiers at Orpington in Kent, where he was chief surgeon. He filled a similar position in the Canadian Hospital at Tapaiv. After returning to Canada at the close of the War he was appointed to the Board of Consultants for Canada. In that capacity he travelled long distances throughout the country, visiting hospitals and rendering service of the highest order.

In acknowledgment of his attainments and his service to humanity he was the recipient of many honors. These included Doctor of Laws of the University of Edinburgh (Hon.), honorary fellowships in the Royal College of Surgeons of England, the Royal College of Surgeons of Edinburgh, the Royal College of Surgeons of Ireland, and the Royal College of Surgeons of Canada. He was also a charter fellow and honorary fellow of the American College of Surgeons. Mr Cameron possessed qualities all too rare in the medical profession. Beyond the limitations of books devoted to medical science, he was a student of general literature and a classical scholar of no mean order. Endowed with an exceptional memory, he was proficient in apt quotation, a power he used with great effect both in public and in private. With these attainments it was natural to find him fastidious in his use of English and intolerant of slovenly methods of expression. A false quantity in pronunciation would often arrest his attention and induce comment. He objected to the term "appendicitis" because it was a hybrid of Latin and Greek and endeavored, I fear unsuccessfully, to induce his students to call it "epityphlitis." There was a charm, almost unique, in his departure from narrow technicalities of medical study and in his effort to interest the student in the broader studies, of a cultivated man of letters.

Withal Mr Cameron was a skillful surgeon enjoying the confidence and deep affection of a large clientele in the community. He was also an inspiring teacher. As a young man he became a disciple of Lister and was among the first to introduce into surgical practice in this country the principles enunciated by that great master. Among the heroes he worshipped, both in science and in literature, Lister stood *facile princeps*. If during one of his annual visits to Great Britain he went to Glasgow he would visit the Royal Infirmary and the old ward where Lister began the investigations that led to his great discovery. That indeed was hallowed ground to Mr Cameron. These visits were akin to paying homage at the shrine of one of the immortals. Little wonder that he was among those who

protested vehemently when, a few years ago, the trustees of the Royal Infirmary determined to demolish the old building. When in spite of protest this "vandalism" was accomplished, Mr. Cameron succeeded in securing a brick from the wall of Lister's ward. This brick was presented to the Faculty of Medicine in Toronto and now lies embedded in the wall of the library of the Banting Institute, immediately below the portrait of Lister. A suitable inscription narrates its story.

Mr. Cameron's unfailing courtesy, his liberal hospitality, and his personal culture and charm secured for him the esteem and devotion of many. His old students and a host of friends and admirers both in this country and overseas mourn his loss.

A. PRIMROSE



medical literature is found in the books of Celsus of the first century A.D. Here is described an operation consisting of dissection and excision of the sac, with or without suture of the wound. This procedure surprisingly advanced in its conception was entirely lost during the Dark Ages and was not rediscovered until the 19th century. Paul of Aegina in the 7th century A.D. described a method consisting of double ligation and excision *en masse* of sac, cord, and testicle. This mutilating and ineffective operation persisted throughout the Middle Ages and represented perhaps the least objectionable of a number of irrational and barbaric methods by which the depth of the decay of medieval surgery may be measured.

One of the widely used among these methods was the cautery. Both the actual iron and escharotics were used and the skin, subcutaneous tissues and fascias were burned down to and including the pubic bone. The wound was then allowed to heal by granulation in the hope that the scar would be sufficiently resistant to prevent further herniation. Other favored methods were the royal operation and the *punctum aurum*. The former so called because it spared the testicle and preserved the generative powers to provide new subjects for the king consisted merely of an incision over the hernia in the direction of the spermatic cord and suture of the sac *in situ*. The latter was devised by Ger aldus of Metz and practiced by Ambroise Pare. It consisted of twisting a gold wire about the cord and sac in the attempt to prevent further descent of bowel into the hernia. Obviously if the wire were tight enough to effect this purpose the circulation to the testis was compromised and if not nothing was accomplished. Other measures consisted of various types of percutaneous ligation of sac and cord with perhaps compression of the tissues by diverse devices and of inversion of skin or other substances into the canal in the hope of blocking the rupture. All of these operations were dangerous in view of the ignorance of the operators and their lack of cleanliness. They were painful and mutilating and offered no real promise of success. It is no wonder then that reputable surgeons as late as the beginning of our own era advised against surgery for the treatment of reducible inguinal hernia.

During this period however the basis for an intelligent approach to the hernia problem was being laid. The anatomy of the inguinal region was thoroughly studied by men whose names are still attached to structures in that area Vesalius Scarpa Cooper Gimbernat Hesselbach. The nature of hernia was established and its various types described. The 19th century brought anesthesia hemostasis and antiseptics the 3 major discoveries that have made modern surgery possible. With the inception of the modern era in surgery attention was again directed toward the radical cure of reducible hernia.

The pioneers of post Listerian herniology Czerny, Lucas Championniere Macewen and Marcy rediscovered, with various minor and insignificant addi-

tions the operation described by Celsus, almost two thousand years before. Thus in twenty centuries, no advance in technique had been made, until Bassini blazed new paths for the development of the surgical treatment for inguinal hernia.

The literature of the period in which Bassini's studies were in progress gives an illuminating picture of the results of hernial surgery of the time. The operations most widely in use were those of Wood and Czerny which like that of Celsus consisted essentially of ligation and excision of the sac, with or without suture of the pillars of the external ring. Halsted in 1890, wrote "Just now most of the so called radical cure operations are under a cloud. They have not withstood the test of time. Modern textbooks of surgery refer to operations for the radical cure of hernia with more or less qualifying. He quoted Bull, who reported recurrence rates of 40 per cent in the first year, and practically 100 per cent failures within 4 years. Bull advised dropping the term cure, and considered operation indicated merely for the temporary relief it afforded.

In the same issue of the *Langenbeck's Archiv* in which Bassini's first full report was made there is a review of hernial surgery from Billroth's clinic, with comparative citations from the literature. The death rate was about 6 per cent and the incidence of recurrences was frightful. Over one third of the operations were failures, and were marked by prompt reappearance of the hernia. The late results were admittedly much poorer.

Bassini's interest in the problem of inguinal hernia dated back to his experiences in the Institute of Pathology in Pavia in 1873. As a clinician, he was impressed by the fact that all of the contemporary radical operations necessitated the subsequent wearing of a truss if recurrence were to be prevented. This was true of the first few patients he operated upon by the prevailing methods. He felt that the essential inadequacy of all the available operations was that the repair depended upon the occlusion of the hernial opening by a single layer of scar tissue, which was further weakened by the passage through it of the spermatic cord. The solution to the problem he thought might lie in a physiological reconstruction of the inguinal canal for the passage of the cord so that it again possessed an internal and an external opening and an anterior and a posterior wall. Applying his knowledge of anatomy and experimenting on the cadaver he evolved his renowned method which he believed fulfilled the requirements of a radical operation that is, it would cure the hernia without necessitating the subsequent wearing of a truss. The first report of his operation was made before the Italian Surgical Society in 1887 and covered a series of 42 cases. The following year before the same body he reported a series of 102 cases successfully treated by his technique. His comprehensive treatise on "The Treatment of Inguinal Hernia" which appeared in the *Archiv für klinische Chirurgie* of 1890 made his discoveries available to the rest of the surgical world.





# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE charge is often made that physicians are so much engrossed in their special field that they give no thought to the larger problems of social and political life. It is true that we have produced few politicians but not true that the physicians neglect the broader cultural fields or social philosophy. Two books have recently appeared that emphasize this catholicity of thought of our profession. Royster's *Medical Morals and Manners* and Elliott's *Scalpel and Sword*.

Royster<sup>1</sup> has gathered together in one volume more than thirty addresses upon general subjects he has given before professional and lay organizations. These papers with their wit, homely wisdom, and keen insight into the working of the common mind of mankind make a most interesting and instructive collection. Some will like 'Surgical Sense' or 'The Humanity of Surgery' others 'Women and the Doctor' or 'Athletics and Scholarship,' and others like myself the thumbnail biographies of Sims, Budd, and Strudwick, but wherever one delves he will turn over nuggets of wisdom and much constructive thought and be fortified in his ideals by the kindly humanity that pervades the whole.

Sir James Elliott<sup>2</sup> (Wellington, New Zealand) brings us something different and most intriguing—chapters from a life that has been filled with most interesting experiences. The North American surgeons will be attracted most by the chapters describing Wellington with the vivid characterizations of its citizens and those that picture the life in New Zealand because so few of us have visited Otago University, known the delightful Macnns or are acquainted with the charming mountains and valleys of Elliott's adopted home. After reading the book one does not need to be told that the author came from Ulster since from every page bubbles up an inimitable Irish humor. Elliott's life in Edinburgh as a student, his experiences in the Boer War, the story of the New Zealanders in the World War and the reminiscences of his travels round out a most readable and interesting book.

ALLEN B. KANAVEL

THE literature of the endocrine glands from the earliest times is reviewed by Sir Humphry Rolleston in his recent classic presentation of the knowledge of the world on this subject.<sup>3</sup> But extraor-

dinary as the review of the fundamental studies to be found in the library is, the value of the book to present day workers derives from its analysis of recent investigations. It is, thus, not only complete but current. Brief biographies scattered through the text as the discussion of a man's work comes up, make an inspiring addition. Into the 500 pages which compose this volume are packed, literally crowded, thousands of references which are given intelligent evaluation. For example the chapter on the pituitary has 14 references on the history, 16 on the embryology, 43 on the anatomy (the last 10 from 1935), 55 on the histology, about 225 on the physiology, 37 on introduction to clinical conditions of the pituitary, about 100 on the history of acromegaly, and about 50 on the pathogenesis, the review of the diseases of the pituitary covers at least 800 additional references, the total for this chapter reaching 1200 titles or more. The study of literature in regard to the thyroid is even more extended. The parathyroids, adrenals, gonads, pancreas and islands of Langerhans, thymus, pineal body, carotid body, coccygeal body, liver, stomach, spleen, and diseases of doubtful endocrine origin are taken up.

Controversial subjects enable the author to bring together the opinions of various men in a manner that is enlightening to the student. The quality of the book in this regard is well illustrated by the following paragraph on the disputed etiology of toxic goiter in which the nervous hypothesis is reviewed: 'Trousseau in 1860 regarded the disease as a neurosis analogous to hysteria. On November 27, 1860, Handheld Jones (1819-1890) read a paper on 'Proptosis, Goitre and Palpitation' before the Royal Medical and Chirurgical Society and concluded that the exophthalmos was caused by effusion of fluid behind the eyeball and that the disease was essentially a debility of the vasomotor nervous system. The paper, not thought worthy of the Society's Transactions,' was printed in its Proceedings, and together with the discussion was reported in the *Lancet*. Subsequently changes were described in the sympathetic by Peter, von Recklinghausen, and Virchow. It was also suggested by Koebner (1865) and Pirry that pressure of the thyroid on the sympathetic in the neck was responsible for the symptoms and in 1897 Pierre Marie adopted this explanation for cases (goitre Basé dowlie) of dyspnea and other symptoms which he distinguished from Graves's disease. In a case recorded by S. Wilks in 1850, Moxon (1836-1886) examined the sympathetic but could not confidently say that it was abnormal. Goodhart in 1874 de-

<sup>1</sup> MEDICAL MORALS AND MANNERS. By Hubert Ashley Royster. M. D. Ch. ped. Hill, N. C. The University of North Carolina Press, 1937.

<sup>2</sup> SCALPEL AND SWORD. By Sir James Elliott. Wellington, New Zealand. A. H. and A. W. Reed, 1935.

<sup>3</sup> THE ENDOCRINE ORGANS IN HEALTH AND DISEASE. By Sir Humphry Davy Rolleston. London, Oxford University Press, 1936.

[illegible]

Photography and drawings with a number of colored plates are liberally used to illustrate the subject matter. Photographs of a number of obsolete and scopes (Beach & Sims) and dilators could have been eliminated. Too much emphasis, both in written and pictorial, is placed on the clamp and cautery type of hemorrhoidectomy, which is rapidly losing popularity. The Whitehead operation is mentioned and discussed, only to be condemned by the author, a fact based on no well founded objections. Great emphasis is in fact not utilized in in detailing diagnostic methods and the importance of thorough pathological examinations.

The section on malignant tumors, covering at least one fourth of the book, presents to the reader with a broad and unbiassed view of every phase of this very important subject. The volume is an ably constituted, well balanced work, which has been and will continue to be useful to proctologists, surgeons, and general practitioners alike.

DRIVING most of the twentieth century Dr Jackson and his associates have been devoting the major portion of their time to educating the profession in the recognition and treatment of foreign bodies in the air and food passages. The latest contribution of the Jacksons is a mass of clinical

facts and data collected from these 30 years of experience. In the 600 pages are to chapters dealing with the etiology, symptomatology, pathology, and treatment of foreign bodies in the air and food passages. In tabulated form are over 3100 consecutive cases taken from the files of the Jackson Clinic. "Diseases of the Air Food Passages or Respiratory Organs" by Chester Jackson, M.D. F.A.C.S. L.D. and Chevalier L. Jackson M.D. M.D. F.A.C.S. (Vet.) F.A.C.S. Philadelphia and Los Angeles W.B. Saunders Co. 1930

also found that the sympathetic system normal. In 1863, T. J. Cooper (181-189) stated that the responsible lesion was in the spinal region of the spinal cord, and in 1874 Lander Brunton (184-1916) suggested that the third cervical ganglion of the sympathetic was the site of disease. The importance of the nervous system in causing symptoms was fully recognized a few years later. Hall of the mendeith ex and Cooper's disease was generally explained on these lines, in his article in *Lancet* (1883) *Myopathia sympathetica* as a synonym, nervous thyro exophthalmique' but in Hilton Fagge's 'Principles and Practice of Medicine' (1886) it was considered among the diseases of the blood vessels. The general impression that exophthalmic goitre was of nervous origin was shown by a discussion in Paris on its relations with tabes in 1888-89 in which Barre, who introduced it, insisted that the signs of exophthalmic goitre might occur in the course of tabes. Ballet and Joffrey also spoke on the subject. "Recently the nervous factor has been partially revived by Labbe and his collaborators (1931, 1933) in the view that toxic goitre is due to a combination

in the view that toxic goitre is due to a combination of (a) hyperthyroidism and (b) a neuro vegetative syndrome or para Basedowism. According to Drouot, Jendelize, and Gault (1934) para-Basedowism, which causes exophthalmos, tachycardia, tremor and goitre, is due to excessive secretion of the thyro tropic hormone of the anterior pituitary.

Following this the thyroïd, thymus, adrenal, and pituitary by hypotheses are similarly presented. We should be extremely grateful to Sir Humphry Rolleston for this monumental summary of the work done in the endocrine field.

PATR STARR

AN EXCELLENT example of a type of publica-  
tion more common in the French than in the  
American literature is *Chirurgie du Cancer du*  
*Poumon*.<sup>1</sup> Modeled perhaps on the inaugural thesis,  
based often on a very meager chemical material, it  
presents a complete review of the literature on the  
subject considered. It is more a work of scholarship  
than of clinical investigation. It is valuable, as this  
volume is valuable, because it collects and con-  
denses and so makes easily available what is else-  
where widely scattered. Here the experimental,  
clinical, and technical aspects of the surgery of can-  
cer of the lung are thoroughly reviewed. The com-  
plete bibliography makes the volume doubly valu-  
able.

**N** THE second edition of his 661 page book on **Proctology**, Frank Yeomans has completely and expertly covered the field of rectal disease.

These readily lend themselves to study so that the endoscopist may find in them a parallel case and the solution to many of the baffling problems which he encounters

A few statistics are of special interest. From an etiologic standpoint over 81 per cent occur in patients under 15 years of age and over 90 per cent are charity or semi-charity, indicating that foreign bodies occur more frequently in the poor. In a series of 1400 cases over 200 were overlooked due to failure to consider the possibility of a foreign body in patients with pulmonary symptoms and over 87 per cent of these gained access through carelessness.

The book is complete with illustrations of typical cases as well as descriptions of and solution of the problem involved in the removal of foreign bodies in different cases.

Undoubtedly this latest work will prove as popular as Dr Jackson's previous writings. It is both enriching and important in its information and will not disappoint those who consult it for a complete solution of the problem which is involved.

JOHN F. DELPH.

THE excellent example set by other recent authors of textbooks on the subject of obstetrics has been followed by Schumann by making his recent book of reasonable size. The volume is not too large either in dimensions or in the number of pages it contains. This means that the subject matter has been condensed to a minimum.

The author has emphasized the fundamentals of obstetrics and has given only brief mention to subjects that are of rare occurrence and the book is notable for its lack of historical data. The author regrets that the latter (historical data) cannot be included in the text but the reviewer feels that this omission is to be highly commended. Students may be referred to the proper source for such information.

The contents of the book are arranged in logical order and this text should be a valuable aid to the student of Schumann since it clearly and briefly deals with the subject of obstetrics from the viewpoint of the author. The book is adequately illustrated and contains a comprehensive bibliography.

CHESTER C. DOWERY

1. A TEXTBOOK OF OBSTETRICS. By Edward A. Schumann, A.B., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Co. 1936.

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

CANCER AND DIET WITH FACTS AND OBSERVATIONS ON RELATED SUBJECTS. By Frederick L. Hoffman LL.D. Baltimore: The Williams & Wilkins Co. 1937.

RECENT ADVANCES IN ORTHOPEDIC SURGERY. By B. H. Burns, B.A. B.Ch. F.R.C.S. and V. H. Ellis M.A. B.Ch. F.R.C.S. Philadelphia: P. Blakiston's Son & Co. Inc. 1937.

SAFE CHILDBIRTH THE THREE ESSENTIALS (1) ROUND BRIM (2) FLEXIBLE JOINTS (3) NATURAL POSTURE. By Kathleen Olga Vaughan M.B. (Lond.) With foreword by Howard A. Kelly M.D. LL.D. Baltimore: William Wood & Co. 1937.

VEIT'S HANDBUCH DER GYNAEKOLOGIE. 3d rev. enl. ed. Edited by Dr W. Stoeckel. Vol. 12 1st half—GESCHICHTE DER FRAUENHEILKUNDE I DIE FRAUENHEILKUNDE DER ALTEN WELT. By Dr Paul Diepgen. Munich: J. F. Bergmann 1937.

HERTZLER'S MONOGRAPHS ON SURGICAL PATHOLOGY. SURGICAL PATHOLOGY OF THE THYROID GLAND. By Arthur E. Hertzler M.D. Philadelphia: Montreal and London: J. B. Lippincott Co. 1936.

SENILE CATARACT METHODS OF OPERATING. By W. A. Fisher M.D. F.A.C.S. 3d rev. ed. Chicago: H. G. Adair Printing Co. 1937.

OPHTHALMOSCOPY, RETINOSCOPY AND REFRACTION WITH NEW CHAPTER ON ORTHOPTICS. By W. A. Fisher, M.D.

F.A.C.S. 4th rev. ed. Chicago: H. G. Adair Printing Co. 1937.

LOMBONARITTE E SCIATICA VERTEBRALE. SAGGIO CLINICO. By V. Putti. Bologna: L. Cappelli 1936.

CHRISTIAN R. HOLMES. MAN AND PHYSICIAN. By Martin Fischer. Springfield, Illinois, and Baltimore: Maryland: Charles C. Thomas, 1937.

THE OCULAR FUNDUS IN DIAGNOSIS AND TREATMENT. By Donald T. Atkinson M.D., F.A.C.S. Philadelphia: Lea & Febiger 1937.

HANDBOOK OF ORTHOPAEDIC SURGERY. By Alfred Rives Shands, Jr. B.A. M.D. and Richard Beverly Raley. B.A. M.D. St. Louis: The C. V. Mosby Co. 1937.

TRAUMA AND DISEASE. Edited by Leopold Braddy B.S. M.D. and Samuel Kahn B.S. M.D. Philadelphia: Lea & Febiger 1937.

THE THYROID AND ITS DISEASES. By J. H. Means M.D. Philadelphia: Montreal and London: J. B. Lippincott Co. 1937.

SOURCE BOOK OF ORTHOPAEDICS. By Edgar M. Bick, M.A. M.D. Baltimore: The Williams & Wilkins Co. 1937.

SYNOPSIS OF PEDIATRICS. By John Zahorsky A.B., M.D. F.A.C.P. Assisted by T. S. Zahorsky B.S. M.D. 2d ed. St. Louis: The C. V. Mosby Co. 1937.

MEDICAL UROLOGY. By Irvin S. Koll, B.S., M.D., F.A.C.S. St. Louis: The C. V. Mosby Co. 1937.

A MANUAL OF RADIOLOGICAL DIAGNOSIS FOR STUDENTS AND GENERAL PRACTITIONERS. By Ivan C. C. Tchaperaud, M.A. M.D. D.M.R.E. (Camb.) Baltimore: William Wood & Co. 1937.

# SURGERY GYNECOLOGY AND OBSTETRICS

*An International Magazine, Published Monthly*

VOLUME 64 JUNE, 1937 NUMBER 6

## THE EARLY RECOGNITION AND TREATMENT OF CERVICAL CANCER

EMIL NOVAK, M D, F A C S, Baltimore, Maryland

THESE is a rather general feeling that the present day treatment of cancer, with surgery and radiotherapy as the chief agencies, is not the treatment of the future. This feeling is based on the hope that sooner or later, whether in the near or distant future, some more direct and effective, perhaps even specific, means of combating cancer will be evolved. For the present, however, no other weapons are available to our hands, inadequate and disappointing as they so often are.

In so far as the treatment of cancer of the cervix is concerned, surgery has been all but abandoned in favor of radiotherapy. The reason for this is simple enough, viz. in comparable groups of cases the percentage of cures obtainable by efficient radiotherapy is just as good as that following competent surgery, while the latter carries with it an inevitable and considerable mortality rate not observed with the proper use of radium. Even before the advent of radium the cry was constantly being heard that surgery had reached its limit in the radical treatment of cervical cancer, and this lament seems even in retrospect to have been fully justified when one considers the magnitude of such procedures as the radical

Wertheim operation. Now one is beginning to hear that not a great deal more can be expected from the further development of radiotherapy, although refinements in technique are still being made, with the hope of improving results a little here and there. What other lines of attack are open to us against this most dreaded of human scourges? The search for the cause or causes of cancer, as we now believe, the group of cancer diseases, must and of course will go on, but no one can tell when the solution will come or whether it will carry with it the suggestion for successful treatment, any more than we can feel sure that a highly effective treatment may not be discovered long before we know the etiology of cancer.

The one conclusion always reached by every student of cancer statistics, the conclusion expressed so frequently that it seems almost hackneyed to repeat it again, is that the factor which, far more often than any other, decides the fate of the patient, is the stage at which the proper treatment is begun. On this conviction are based all our efforts to educate the laity and the profession. With the public we are concerned chiefly with instruction as to the possible significance of premalignant and early symptoms and lesions. With the members of our own profession, who are supposedly familiar with these things, we preach

alertness, conscientiousness, and thoroughness, we try to instruct them as to the characteristics of lesions which should put them on their guard, and we urge them to lose no time in having doubtful and suspicious cases authoritatively decided and proper treatment instituted.

After all, however, doctors are people, and not all are responsive to exhortations and instructions of this sort. Reams have been written on this subject, but every gynecologist of experience can testify that within the ranks of our own profession there is still open to us a real opportunity for improvement, and one for whose existence there is less excuse than for the corresponding and perhaps larger field of possibilities which concerns the public generally. It is really a harsh commentary on our profession, after all our campaigns of public instruction on cancer, that patients who, either by accident or through their own intelligence or alertness, come under medical supervision may still lose their chance because the physician falls down on the job.

*What is early cancer?* The term early, as applied to cancer of the cervix, is a very relative one. For practical purposes, it would be an enormous advance if the majority of cancer patients could be given the benefits of proper treatment at a stage when the cancer is confined to one lip of the cervix, when it measures not more than a centimeter or so in diameter, when there is no infiltration of the broad ligaments, and when the uterus is freely movable. If all physicians could be trained to recognize cancer in these early stages, an enormous stride forward would have been made, and perhaps this is the immediate goal we should set for men in general practice.

No physician who takes the time and trouble to inspect and palpate the cervix—unfortunately there are still some who do not—can fail to diagnose an advanced cancer. Even the painstaking man, however, may overlook the earlier lesions for the simple reason that his mental image of cancer is that of the late stages—the cauliflower like growth, the necrotic ulcer, or the very hard, stony and irregularly enlarged cervix. The message for this man must be that the appearance of early

cancer is not at all like that which he pictures, and that cancer must be suspected even though there is no large vegetative growth and no large ulcer, if, for example, the cervix presents an unusually hard area, with usually slight superficial ulceration, or if it is the seat of a finely vegetative and usually rather firm excrescence, with bleeding on slight touch.

He must also understand that such lesions may be so inconspicuous that they are missed on any but the most careful examination, including not only palpation but also inspection in the best possible light. He must, in short, develop the habit of going through each cervix with a fine tooth comb, and, what is just as important, making sure that every doubtful case is definitely decided. For not only he, but also the most expert gynecologist will find cases in which clinical methods can not make the diagnosis without the aid of the microscope. But it is this group, in which both the patient and the doctor must go to considerable trouble to make the diagnosis, which will yield the largest proportion of cures.

The general practitioner who encounters the combination of suspicious symptoms and a suspicious cervix, or who finds a suspicious cervix even without symptoms in the course of a pelvic examination, owes it to his patient to have the diagnosis authoritatively decided, as it can be in almost every case. It is no disparagement to say that he is himself rarely qualified to do this, since the decision in such cases depends on a properly performed biopsy and a correct pathological interpretation. He will usually wish to transfer this responsibility to the gynecologist trained in such procedure. But if he is thorough and conscientious he will not rest until the suspicion is confirmed or disproved, rather than merely hope that cancer does not exist, or wait until the clinical diagnosis is plainly evident, with the loss too frequently of the patient's chance for cure.

The contribution, therefore, which can be made to the cancer campaign by the rank and file of our profession is to develop habits of thoroughness in the examination of cervixes, especially of those in women beyond thirty, and of course of those who have observed any abnormal bleeding or discharge, to study such

lesions which resemble cancer in some respects and in others do not, that we have the most promising field for investigation. This is true not merely or chiefly because of the possibilities of improving cancer prognosis, but of bridging the gap, always in the past quite sharply defined, between normal and malignant growing epithelium.

Up to a few years ago there was only a very small proportion of cervical cases in which there was doubt as to the microscopic diagnosis between malignancy and non-malignancy. This general statement is still true, but there is nevertheless an increase in the number of cases in which diagnosis differs according to the individual interpretation of the pathologist. Two factors are responsible for the development of this relatively new zone of pathological uncertainty. The first is the increasing number of specimens submitted from biopsies of cervix in either very early cases of cancer or, even more, from cervixes which are merely suspicious. This increased interest in the cervix is not entirely explainable by educational awakening of the public, important though this may be. In many clinics, however, the new interest in the search for supposed precursors of cancer, such as leukoplakia, and the development of aids in this search, especially the Schiller iodine staining test and the use of the colposcope have yielded much material in which new angles of microscopic diagnosis must be considered.

The second reason for the difficulties in a small but increasing number of cases comes from the still very wide open question of the microscopic criteria of very early carcinoma. The chief issue which has arisen is this, viz. Is the microscopic diagnosis of cancer justified on the basis of anaplastic cell changes alone, without evidence of invasiveness, and is it permissible to view when there is as yet no evidence of invasion as epithelial growth? It is through the basic anaplastic changes that a highly suspicious and a malignant rate have developed with increasing frequency. Up to a few years ago many of us felt that the definite evidence of invasion or invasion in change, such as polyomorphism, hyperchromatic

All this may sound rather utopian, but it represents an avenue of attack rather in immediate possibilities than any other except the education of the public itself. In this connection one other important function of the medical adviser, and also of the gynecologist, should be to carry on an individual cancer educational program of his own, with the individual patients who consult him, perhaps for other reasons. In no other way can the patient be put on her guard in her future more decisively and perhaps so reassuringly than by such a prophylactic consultation with a sensible and intelligent medical adviser.

*The earliest stages of cancer* The particular problem to be discussed in this paper, however, has to deal with the diagnosis of even earlier lesions, lesions which perhaps in the present state of our knowledge we are justified in speaking of as the earliest stages of cancer. The problem therefore is one which concerns the specialist—the gynecologist and the pathologist—rather than the general practitioner, for the final decision in such cases must almost be dispensed with in the more advanced cases.

From cases in which the gross characteristics of the lesion make the diagnosis reasonably certain, to those in which a mere glance through the low power of the microscope reveals the undoubtedly malignant nature of the lesion, we are now passing through a stage in which careful study of the individual cell characteristics must be involved, with diagnostic decisions which in no way always be so definite or so unanimous as in the outspelled forms of the disease. And yet it is in these earliest stages of cancer, or of

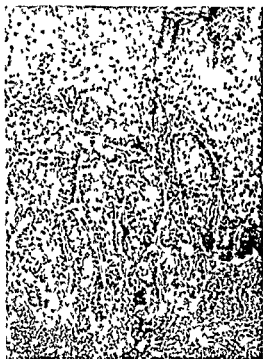


Fig 1 Early epidermoid cancer of the cervix measuring only a few millimeters in size but showing already the same anaplastic and invasive features characterizing the most advanced lesions



Fig 2 Anaplastic cell nest located far beneath the surface in the small cancer of the cervix that is shown in Figure 1 illustrating rapidity of invasiveness of even the early lesions

tosis and mitosis, could scarcely be explained except on the basis of malignant overactivity, and this is still the view of many, perhaps the majority of experienced pathologists. The disturbing factor which has been projected into the picture is the occasional finding of just such anaplastic changes in the epithelium of cases in which there is no clinical evidence of malignancy, and in which the simplest surgical procedure, such as mere excision of the suspected area, has not been followed by the materialization of cancer. Are such cases of intra epithelial carcinoma, or carcinoma *in situ*, or Bowen's disease, or carcinoid, as they have been variously called, really instances of very early, latent, but ultimate and inevitable cancer, or, is the epithelial change, so to speak, still in a not irrevocable stage so far as the development of cancer is concerned?

The material available for the study of this particular problem in cervical pathology is still much too meager to draw final conclusions, and the impressions of most patholo-

gists on this question must necessarily be colored by their convictions as to the general nature of the cancer process and by analogy with similar lesions elsewhere. Lesions of the type described are rather rare, and their accumulation from the current material of even large clinics is a slow process, justifying no conclusions until the follow up results are available. Even these are not of the simple nature of laboratory experiments, because the patients' welfare must be the prime consideration, and a doubtful lesion can not be allowed to remain and unfold its nature, perhaps to the great detriment of the patient. We are thus usually denied the opportunity of observing what would have happened to the patient as a result of a given lesion had it been allowed to remain, and had not excision, or cauterization, or cervical amputation, or even hysterectomy or radiotherapy been resorted to. A quicker way to accumulate material for the immediate present would seem to be to go back over all the cervical material in our laboratories, to search for lesions of this



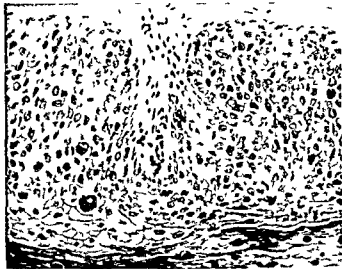


Fig 3 Microscopic section showing Bowen's disease of the skin (This illustration is reproduced from Bowen's original paper)

In the overwhelming majority of the cases of clinically early carcinoma of the cervix, by present-day standards, the pathological diagnosis is simple enough, for all the microscopic criteria of malignancy, including invasiveness, are just as clearly stamped as they are in the latest phases. But there are surely stages preliminary to this, stages in which, as most of us believe, the cancer summons has been served upon the epithelial cells, whether from within or from without, stages in which the later penetration of epithelial cells through the basement membrane has not yet had time to manifest itself (Figs 1 and 2).

In even the very early cancer of unques- tioned type, with invasiveness already estab- lished, we are dealing with an exact miniature of late cancer, with precisely the same histo- logical and growth characteristics. But the invading epithelium has its origin from the surface epithelium, and almost a priori there must be an earlier phase during which the epithelium has not yet gotten out of bounds. These theoretical considerations lend much justification to the growing belief that this pre invading stage corresponds to the picture



Fig 4 Microscopic appearance of leucoplasic area showing cell activity not unlike that of Bowen's disease of the skin. The hyperkeratosis seen in this case is not an invariable finding

of so called intra-epithelial cancer, in which all of the cell characters of cancer are observed, though invasiveness can not be demonstrated. While such lesions are relatively rare, they are being reported with increasing frequency and under various names. In our own laboratory we have been, for the time being, designating them, as have various others, as Bowen's disease of the cervix, because of their essential similarity to the so called Bowen's disease of the skin (Figs 3 and 4).

This interesting dermatologic condition, described by Bowen in 1912 under the name of intraepithelial carcinoma which may show no invasiveness perhaps for many years, when it assumes all the characters of genuine cancer, including invasiveness and metastasis. Is it not possible for similar lesions in the cervix to remain similarly latent for long periods of time, thus explaining their ready cure in this stage, viz. very simple and conservative meas- ures? The only doubt would seem to be as to the inevitability with which they assume the other commonly accepted characters of malig- nancy, viz. invasiveness (Figs 5, 6, 7).

It should be remembered that, after all, knowledge has come chiefly from the study of



Fig 5 To left is an early epidermoid cancer of the cervix, on opposite lip is an area of non invasive intra-epithelial carcinoma with characteristics not unlike those of Bowen's disease

outspoken cases. May it not be, however, that the anaplastic cell changes so characteristically associated with malignancy may likewise be seen in lesions which still are to all intents and purposes clinically benign? This does not mean that such lesions have no relation to cancer, for the exact opposite would seem to be the case. The very incomplete evidence as yet available suggests that the so called Bowen's disease of the cervix is really a precursory, pre-invasive phase of cancer but that it may remain latent in this clinically non-malignant phase for long periods of time. Schiller's designation of intra-epithelial carcinoma as actually 'beginning cancer' does not seem to me justified in the present state of our knowledge. A better term would seem to be precancerous anaplasia.

There are very obvious limitations in drawing conclusions as to the nature of cancer from histological and clinical studies alone, but on this basis one gets the impression that the transition of normal epithelium to carcinoma is in two steps. The first of these is concerned with the cell changes especially de-differentiation and increased growth propensities, the second with the inhibition of some growth restraint which normally limits epithelial growth to its own side of the basement membrane. Apparently too, there may be a definite and perhaps long lag or pause between the two steps.

A very important point in the evaluation of

Bowen's disease of the cervix is the fact that it quite perfectly resembles the picture so often seen at the growing margin of very frank cervical cancer, as Schiller has so well emphasized. It would almost seem, though this must for the present be considered a figure of speech rather than a demonstrable fact, that around the cancer there is an area in which the epithelium, especially in its basal layers, is being lighted up into cancer activity. The cells of the epithelial layer are compactly placed, while hyperchromatism, polymorphism, and mitotic activity are marked, and here again we have in these peripheral zones the picture of intra-epithelial carcinoma without invasiveness. The junction of this zone with the normal epithelium is sharply defined and often oblique, because of the deeper extension into normal tissue of the basal layers than of the superficial, as Schiller and others have emphasized. The mere fact, therefore, that this growing margin of actual cancer so closely resembles Bowen's disease is circumstantial evidence of a relation between the two, and of the precancerous nature of Bowen's disease.

There are other cervical conditions in which varying degrees of cell overactivity may be noted. One which is now very much in the limelight is leucoplakia, of which almost nothing was heard until a few years ago. In certain other parts of the body, especially the tongue and the vulva, the precancerous nature of leucoplakia has been accepted for many years, but it was not until the work of Hinslmann, based on colposcopic studies of the cervix, that the relatively frequent occurrence of cervical leucoplakia became recognized. Unfortunately, the term is a rather loosely applied one, embracing varying degrees of hyperkeratosis, parakeratosis, papillary enlargement, and evidence of overactivity of the cells. Indeed, Hinslmann's own interpretation of the term includes the cases I have described above as Bowen's disease, as well as cases of early carcinoma. He distinguishes four grades or rubrics of the lesion, varying from simple cornification of the epithelium at one extreme, to cornification, plus marked atypia of cells, plus budding into the connective tissue at the other extreme.

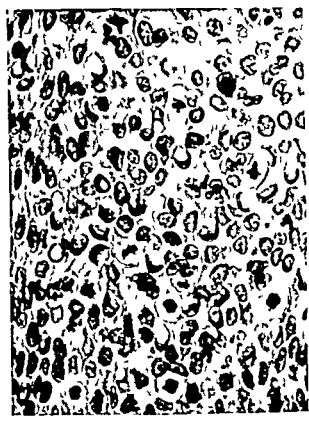


Fig 6 High power of cancer shown in left of figure 5 illustrating characteristic amaplastic cell features of malignancy

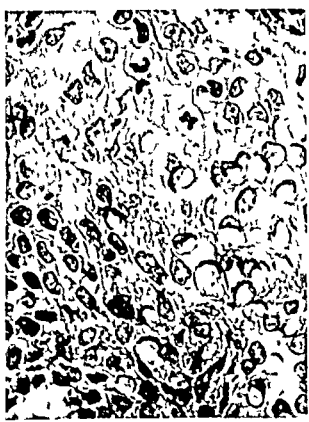


Fig 7 High power of non invasive cell changes similar to those in figure 6 of cervix (to right in Fig 5), showing cell changes similar to those in figure 6

In the milder grades of leucoplacchia there is no microscopic resemblance to cancer, although Hinselmann believes that leucoplacchia in general must be considered a precursor of cancer, a view with which many good pathologists disagree. Certainly the chiasm between the milder grades of leucoplacchia and cancer is a very wide one indeed, while that between his rubric IV and cancer is indistinguishable. Whatever one's opinion may be on the pathological aspects, and what-ever one may think of the value of the colposcope, it seems to me that Hinselmann has rendered a very great service in emphasizing the value of very intensive and painstaking study of the cervix in the search for early cancer (Figs 8 and 9).

The magnification of the cervix afforded by his colposcope or any of the modifications which have been devised (a very good apparatus which I myself use is manufactured by an American firm) is really quite educational, giving one a new clinical slant on cervical pathology. The method, however, is time-consuming and its value significant only with increasing experience. I do not believe that the additional information which it gives, above that of simple and thorough inspection of the cervix in a very good light, is as great as Hinselmann believes it to be, nor do I think it will reveal any large number of early cancers that a good gynecologist would not discover with the simpler methods of inspection. Moreover, it is not the sort of diagnostic aid which is adapted for general use among general practitioners, for it is valueless without a knowledge of the significance of the cervical pictures which are revealed, and without a proper pathological interpretation of these lesions after biopsy.

In competently manned clinics, however, the apparatus is a real asset, for it will serve to keep constantly before the staff members the fact that the recognition of early cancer is not a mere matter of palpation and casual inspection, but that it requires very conscientious and painstaking study by one method or another. It is of no practical value in the study of outspoken cancer, and indeed it is meant chiefly for the "accidental" finds, since



Fig 8 Section from small area of leucoplacia not taking the iodine stain with Schiller's test and showing merely hyperkeratosis and slight increase in cell activity but with no suggestion of malignancy

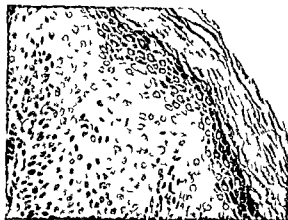


Fig 9 Another leucoplacic area Here again are shown hyperkeratosis and some increase in cell activity and a few mitoses but there is no suspicion of malignancy

the lesions which it aims to reveal are so commonly symptomless. It should logically therefore, though this is rarely feasible, be employed in almost a routine fashion.

It is of interest to note, from a recent report by Lonne, that during the 10 year period during which Hinselmann has employed the method, he has examined a total of 18 000 patients with the colposcope, and that among these he discovered 450 instances of leucoplacia, of which 2 per cent proved to be malignant. In 87 of his cases diagnosed as malignant the diagnosis was confirmed in only about one half the cases by a group of three expert pathologists (Meyer, Schridde, and Rössle). It is illuminating, too, from the standpoint of the thoroughness of the study required with such material, to learn that as many as 1,200 to 1 500 sections were made of some 500 cervixes which had been amputated.

**The Schiller test.** What has been said as to the limitations of colposcopy applies very largely to the employment of the Schiller tinctorial test, whether combined with colposcopy or not. The method is based on the fact pointed out by Lahm that the normal vaginal mucosa, as well as the stratified squamous epithelium of the pars vaginalis, is rich in glycogen. Cancer epithelium, however, is glycolytic, and this fact has been utilized by Schiller in the iodine test which he devised. This consists in painting the cervix thoroughly with Gram's solution, consisting of 1 part of

iodine and 2 parts of potassium iodide to 300 parts of water. This solution gives better results than Lugol's solution, which has often been used for the test. Schiller advises that the solution be poured into the vagina and liberally mopped over the cervix, with care to avoid traumatism of the mucous membrane, as this may lessen its tinctorial response. Henriksen suggests as a modification that the solution be sprayed freely over the cervix with an atomizer. Excessive mucous secretion should first be gently removed, and after a half minute or so, to allow the stain to take hold, excess solution should be sponged out.

Normally the squamous epithelium of the cervix takes a homogeneous deep mahogany brown stain, while cancer areas remain unstained, so that they stand out in sharp contrast. Unfortunately, the matter is not quite so simple and decisive as this, for other lesions which are not malignant, especially leucoplacia, also remain unstained, while traumatism of the mucosa may also interfere with the staining reaction. The cylindrical epithelium of the cervical canal normally takes a rather light brownish pink stain, and this must be taken cognizance of in the cervixes in which eversion or erosion is present, as it so often is. In ulcerated carcinoma, a dirty brownish stain may be assumed in the ulcerated area, though a whitish zone may be noted surrounding this, corresponding to the advancing margin of growth.

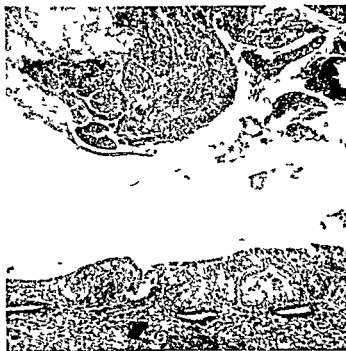


Fig 11 Showing the contrast between benign epithelial midriation on one lip of the cervix (above) and real cancer on the other lip (below)

*Squamous metaplasia stimulating cancer*

There is one other group of cervical lesions which can not be overlooked in any discussion of the microscopic diagnosis of early cancer, particularly because of their very great frequency, far greater than of those already discussed. I refer to the so called squamous metaplasia, or epidermidization, seen so often in chronic inflammation of the cervix, as well as in polyp. I have discussed the characteristics and the mechanism of this interesting change rather fully in a previous paper, so that I shall not elaborate upon it here. Suffice it to say that the condition is characterized by the presence beneath the cylindric epithelium of the cervix, either on the surface or in the glands, of columns or islands of squamous epithelium which often proliferate extensively, so that they frequently obliterate the cylindric gland epithelium and fill the gland. In advanced cases one sees columns and nests of this epithelium scattered throughout the stroma, so that there is more or less resemblance to the epidermoid cancer. The distinction can usually be made by the normal, non anaplastic character of the cells, and by the fact that the squamous growth follows the scaffolding of the glands. Practically always,



Fig 10 Marked epidermidization or "squamous metaplasia" of cervix, producing an appearance which might lead to suspicion of malignancy if one is not familiar with this picture

The whitish areas of leucoplacia, like those of early cancer, are characteristically to be looked for at the junction of the squamous and cylindric epithelia. The leucoplacia areas may be single or multiple, very tiny or at times quite extensive. Since the distinction between a leucoplacia area and a very early cancer can not be made on the basis of the Schiller test alone, the chief value of the test would seem to be to point out areas for biopsy. It is probable, therefore, that few general practitioners will wish to assume the responsibilities of the Schiller test themselves, carrying with it the further responsibilities of pathological interpretation, and that they will usually prefer to transfer the problem to the specialist. Furthermore, as was emphasized with reference to the colposcope, the Schiller test is of little additional value in the detection of outspoken cancer, its possibilities being greatest in the routine examination of cervix of patients who have no symptoms of cancer. Once bleeding occurs, it may be assumed that ulcerative changes have already begun, and diagnosis is usually easy, at times pathetically so, even without such refinements as this test

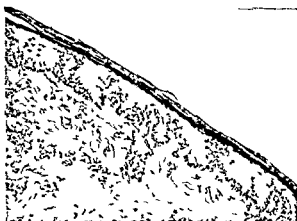


Fig 8 Section from small area of leucoplacia "not taking the iodine stain with Schiller's test and showing merely hyperkeratosis and slight increase in cell activity but with no suggestion of malignancy

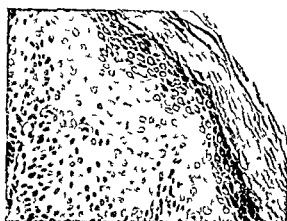


Fig 9 Another leucoplacic area Here again are shown hyperkeratosis and some increase in cell activity and a few mitoses but there is no suspicion of malignancy

the lesions which it aims to reveal are so commonly symptomless. It should logically therefore, though this is rarely feasible, be employed in almost a routine fashion.

It is of interest to note, from a recent report by Lonne, that during the 10 year period during which Hinselmann has employed the method, he has examined a total of 18 000 patients with the colposcope, and that among these he discovered 450 instances of leucoplacia, of which 2 per cent proved to be malignant. In 87 of his cases diagnosed as malignant, the diagnosis was confirmed in only about one half the cases by a group of three expert pathologists (Meyer, Schridde, and Rössle). It is illuminating too, from the standpoint of the thoroughness of the study required with such material to learn that as many as 1 200 to 1,500 sections were made of some 300 cervixes which had been amputated.

**The Schiller test.** What has been said as to the limitations of colposcopy applies very largely to the employment of the Schiller tinctorial test, whether combined with colposcopy or not. The method is based on the fact pointed out by Lahm that the normal vaginal mucosa, as well as the stratified squamous epithelium of the pars vaginalis, is rich in glycogen. Cancer epithelium however, is glycolytic, and this fact has been utilized by Schiller in the iodine test which he devised. This consists in painting the cervix thoroughly with Gram's solution, consisting of 1 part of

iodine and 2 parts of potassium iodide to 300 parts of water. This solution gives better results than Lugol's solution, which has often been used for the test. Schiller advises that the solution be poured into the vagina and liberally mopped over the cervix, with care to avoid traumatism of the mucous membrane, as this may lessen its tinctorial response. Henriksen suggests as a modification that the solution be sprayed freely over the cervix with an atomizer. Excessive mucous secretion should first be gently removed, and after a half minute or so, to allow the stain to take hold, excess solution should be sponged out.

Normally the squamous epithelium of the cervix takes a homogeneous deep mahogany brown stain, while cancer areas remain unstained, so that they stand out in sharp contrast. Unfortunately, the matter is not quite so simple and decisive as this, for other lesions which are not malignant, especially leucoplacia, also remain unstained, while traumatism of the mucosa may also interfere with the staining reaction. The cylindric epithelium of the cervical canal normally takes a rather light brownish pink stain, and this must be taken cognizance of in the cervixes in which eversion or erosion is present, as it so often is. In ulcerated carcinoma, a dirty brownish stain may be assumed in the ulcerated area, though a whitish zone may be noted surrounding this, corresponding to the advancing margin of growth.

I have said nothing as to the supposed danger of biopsy because of the possibility of disseminating cancer cells. There has never been any worthwhile evidence that this is a hazard of importance in this field, and, as a matter of fact, there is considerable evidence to throw doubt upon its harmfulness in any field of the body. The practical point, however, is that even if there were some danger attached to biopsy, it would still be both justified and necessary, for how else can we settle the vital question of diagnosis in doubtful cases?

THE VITAE

Having devoted so much time and space to the matter of diagnosis, the question of treatment may be considered only rather briefly and along general rather than detailed lines, especially as these details have been so fully discussed by others during the program of this Institute. It is now generally accepted that the backbone of our present day treatment of cervical cancer is radiotherapy, for reasons which I have indicated in the early part of this paper. The old discussion of surgery versus radium has been replaced by the question of whether there is now any place at all for radical surgery in the treatment of this disease.

In many clinics operation has been virtually abandoned, but there is noticeable a growing tendency to modify this policy by adopting a combination of surgery and radium in at least a selected group of cases. In those patients in whom the disease is in a relatively early stage, when the patient's general condition is favorable for a major surgical procedure, when the surgeon is well trained in the technique of the radical operation, and especially when the cancer is of the highly differentiated type which is characterized by a low degree of radiosensitivity, the radical operation is a rational procedure. The mortality rate in this group should be low, and is probably at least counterbalanced by the fact that the cancer tissue is actually removed rather than subjected to the destructive effects of radium. This advantage applies especially to the cases in which the cancer cells are of the highly differentiated type known to be relatively

With the exception of these limited groups vaginal procedure of those highly trained in the technique of the definite advantages, especially in the lower mortality accompanying its use in the hands of those highly trained in the technique of the vaginal procedure.

With the exception of these limited groups of the cervix is entirely a matter of proper radiotherapy, with the combined use of radium and the x-ray. In Baltimore this treatment is referred entirely to a group of trained radiologists, and Dr. Burnam, who has directed this work for many years, has reported his technique and his results in various papers, so that there is no need for discussing details here, even were I qualified to do so. There is still considerable difference in methods, and improvements and refinements are still being derived in an effort to improve results. The dangers of radiotherapy are real, and the morbidity attending the method has been



Fig 1 Case 1 A F J T a man aged 49 years referred March 27 1925 by Dr F J Dever on account of carcinoma of the glans penis which had existed for 1 year He was treated successfully by radium x rays and electrocoagulation A 3 years later June 8 1928 the patient returned with a history of hematuria for 6 months The pneumocystogram shows an ulcerating broad based tumor of irregular density occupying the left wall of the bladder and extending over toward the region of the left ureter It projected into the bladder 5 centimeters and the base was 3 centimeters A second tumor on the posterior wall of the bladder was approximately 2 centimeters in diameter B After treatment by high voltage roentgen therapy and also by cystoscopic electrocoagulation done by Dr Wilbur Haines A pneumocystogram made May 8 1929 shows tumors entirely gone The bladder is normal throughout The patient is well more than 7 years after treatment

#### METHOD OF EXAMINATION

Briefly, the examination of the bladder by pneumocystography requires the following

- 1 The patient is placed in the supine position upon the Potter Bucky diaphragm with preliminary arrangement of the tube and compression band as for an examination of the bladder

- 2 The urethra is carefully cleansed antiseptically

- 3 A sterile, well lubricated soft rubber catheter of the largest size that the urethra will take is introduced

- 4 The retained urine is drained The quantity and character of this urine is noted

- 5 A rectal tube is passed to remove any retained gas in the rectum, and then removed

- 6 With an atomizer bulb, attached to a properly fitting glass tube which connects the catheter air is gently injected into the bladder until the patient complains of a desire to urinate or until percussion indicates that the bladder is distended

- 7 The air is allowed to escape 2 or 3 times This will commonly remove some additional residual urine It is desirable to eliminate all

possible residual urine, which may diffuse or obliterate the shadow of the tumor

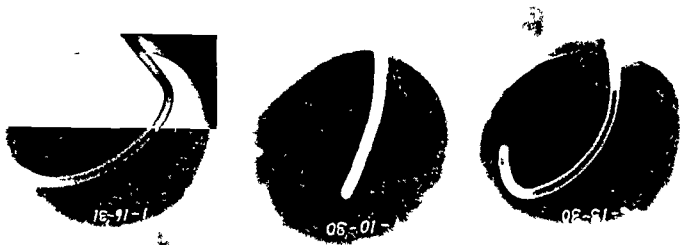
- 8 The soft rubber catheter is clamped with a pair of hemostatic forceps and these forceps are attached with adhesive plaster to the thigh so that the catheter will not come out and the air will not be expelled

- 9 The central beam of roentgen rays is directed downward and forward and with the patient in the supine posture, three or four 8 by 10 inch negatives are made

- 10 The catheter is held in place while the patient turns to the prone position on the Potter Bucky diaphragm most cautiously so as not to have the catheter and the air expelled

- 11 Three or four 8 by 10 inch negatives are made with some variation of exposure value with the central beam of rays directed obliquely upward, so as to project the neck of the bladder clear of the pubic bone A film made with patient in the prone position usually shows the tumor best because such films usually involve the posterior or lateral wall of the bladder, and in this position are therefore surrounded by air According to O Crowley,





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Fig. 2 Case 2 Mrs. C. W. S., aged 55 years, was referred by Dr. J. M. Andersen, June 13, 1930, on account of hematuria, for several months. A "runner irregular in outline, with a broad infiltrating base surrounding the ureters, about the size of a hen's egg. The patient was given high voltage roentgen treatment. B, After 3 months, on September 10, 1930, re-examination showed that five sixths of

27 37 per cent involve the triangle, 41 89 per cent involve the lateral walls, 5 89 per cent involve the bladder neck, 10 92 per cent involve the posterior wall, 7 85 per cent involve the vault, and 6 32 per cent involve the anterior wall.

12 The patient is rotated in the oblique  
prone position, first on one side and then  
the other, and the central ray is passed  
through the median line of the bladder, one  
8 by 10 inch film being made in each position.  
13 The patient is rotated cautiously to the  
back, the clamp is removed, the air is allowed  
to be expelled, and the catheter is withdrawn.  
14 The patient can then leave the table.

In only one case in several hundred has there been any chill or other unpleasant symptom following these examinations. There is no real danger of embolism following this procedure if the work is carefully done.

## INTERPRETATION

We have succeeded in demonstrating both benign and malignant tumors, varying in size from 1 to 8 centimeters. It is not always possible, of course, to make an exact pathological diagnosis by means of a microscopic study, and whether the tumor is malignant or benign, just as it is not always possible to make a

diagnosis cystoscopically or macroscopically. In general, however, if a tumor is small, sharply defined and pedunculated, and especially, if there are multiple tumors, the probabilities are that it is benign. If it is large, irregular on the surface, and associated with a broad base, it is probably malignant, and if it is infiltrating in character, it is I think always malignant. If the tumor has definitely infiltrated the bladder wall so that it can not be removed normally, one obtains more definite evidence of a malignant growth than could be obtained cystoscopically.

Since urologists state definitely that all tumors of the bladder are potentially malignant, the important matter is to demonstrate the tumor and to get rid of it by the best means possible, according to the indications in any individual case.

## TREATMENT OF TUMORS OF THE BLADDER

through the use of the various combinations of the treatment of the seed, such as (1) the excision, preceded or followed by (2) a disinfection of the surface of the seed, (3) a disinfection of the seed, and (4) a disinfection of the seed, followed by a disinfection of the seed.

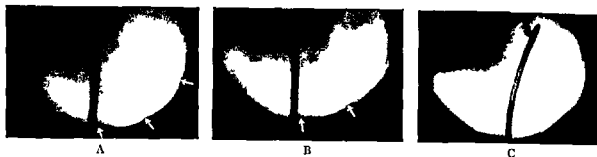


Fig 3 Case 3 Mrs F McG aged 43 years referred by Dr Albert Bothe on October 26 1933 had hematuria 6 weeks following a fall with no pain A Cystoscopic examination and pneumocystograms show a sharply defined tumor approximately 2 centimeters in diameter located about 5 centimeters to the left of the urethral orifice This tumor has associated with it the shadow of a second smaller tumor which has double the density but which is still sharply defined A second papilloma is located at the left border of the sphincter and approximately 0.5 centimeter in diameter A third papilloma is located about 8 centimeters to the left of the sphincter All these lesions have

the appearance of being benign as determined both by cystoscope and by pneumocystogram No biopsy was done B December 4 1933 these lesions were reduced in density and reduced in size, approximately 40 per cent The third lesion at the left wall of the bladder is entirely gone Following this pneumocystogram, Dr Bothe destroyed the remainder of the tumors cystoscopically C May 7 1934 the tumors were entirely gone and the bladder wall was smooth and healthy The depression in the upper right border is due to the distended cecum The patient has remained in excellent health during a period of 3 years

trocoagulation, and surface application of radium to the base of the tumor, (5) preliminary roentgen therapy, local destruction, subsequently followed by additional roentgen therapy, and (6) high voltage roentgen therapy, with high filtration, supplemented, if necessary, with electrocoagulation (through the cystoscope) of any remnant that does not respond to irradiation Our most brilliant results, which have been the most pleasing to the patients, have been obtained by the last method

In the discussion of this subject before the Pan American Congress in 1934, Dr James K. Young stated that 75 per cent of cancers of the bladder are inoperable when they come to see him O'Crowley says, "In view of the fact that those tumors on the lateral wall usually involve the ureteral orifices, it can be seen that these tumors located in this region with those on the trigone and bladder neck constitute 76.6 per cent This therefore brings out clearly the fact that in only 23.4 per cent of tumors is it possible to apply complete excision without interfering with the ureter or urethra" It is my opinion that any method of treatment that will get a patient well should be used, and that method should be chosen which will give the least risk to the patient, the least damage to his tissues, the least interference with his work or body func-

tions In the 23.4 per cent of tumors, therefore, there is naturally debatable grounds as to the best method, but in the other 76.6 per cent, the roentgen treatment will certainly meet these demands more completely than anything else that is known

Simple benign tumors are being destroyed daily by urologists by cystoscopic electrocoagulation, but it is also well known that these tumors commonly recur after such treatment Therefore, it has seemed to Dr Bothe and me that it would be advisable to give preliminary irradiation, then destroy the tumor and follow with an additional moderate amount of irradiation We have had some success by this procedure

In dealing with large and definitely malignant tumors, no rule or definite plan of treatment can be laid down at the present time Each patient must be treated according to the individual conditions present, the general principles of treatment and the general condition of the patient must be kept in mind Therefore, it is not merely a problem of physics Such a plan of treatment can probably be best and most practically made if there is a conference with the family physician, the urologist and the radiologist, for all three of these physicians need to co-operate in order to obtain the best results in the greatest number of cases The principles involved are

plied with blood vessels, therefore, these small vessels are apt to be closed by an end-arteritis due to the heavy irradiation, and such fatty tissue is more apt to be followed by fibrosis or necrosis than other tissues. This must be kept in mind in planning the treatment

5 Repeated checks must be made to determine what has been accomplished, and the treatment is supplemented when necessary so as to eliminate all of the disease. This should be done according to the indications, both by pneumocystography and by means of cystoscopy. I think I failed on one case because I did not have a cystoscopic examination made when I thought the patient was well, as determined by the pneumocystograms, and stopped treatment too soon

Generally speaking, these patients are able to come back and forth for their treatments, and usually, they are only interfered with in their usual occupation or affairs for the time involved in the actual treatment. If patients have lost much blood by hemorrhage or are very anemic, they must of course conserve their energies in every way possible, and therefore, should be kept at rest. Patients whose general health is good to start with usually do better. I have treated two physicians who had each a large practice, and who continued their practice during their entire treatment

#### RESULTS OF TREATMENT

Generally, there is a cessation of hematuria at the end of 3 or 4 weeks. This does not indicate, however, that the disease has disappeared. In one case, the hematuria ceased at the end of 3 weeks, the tumor only showed reduction of about 25 per cent after a period of 4 months, and then there was rapid reduction, and at the end of 6 months, a remanent was destroyed by electrocoagulation. There has been no recurrence at the site of that tumor since *Some benign papillomas* developed about the urethral orifice which were controlled by a combination of electrodesiccation and irradiation. In the more sensitive type of tumor, there is very decided reduction in the size at the end of a month, but in others, as indicated, there is almost no change. It must

4 It should be our aim to direct the irradiation to the tumor and any adjacent likely extension. I have failed on 2 cases, as I will demonstrate to you, because I did not reach the outlying disease. The pneumocystograms are especially useful in outlining the extent of the growth and in locating its exact position. The radiologist should then direct his beam of rays into this area conserving the normal tissues in every way possible. One must be especially cautious about damage to the subcutaneous tissue of a fat abdominal wall. As has been observed by every surgeon, the fatty tissue in the abdominal wall is not well sup-

possible healthy and comfortable condition as is given sufficient to keep the patient in as from time to time. Tonics and medication are study in the beginning, and this is repeated. We therefore ask for a careful blood the radiation becomes exhausting to the patient. We therefore ask for a careful blood from the effects of the carcinoma, and even the patient may be anemic from loss of blood, much radiation sickness in these cases, but condition. Generally, we are not involved with-ner consistent with the patient's general con-3 The treatment must be given in a man-tion of the essential organs to do this properly of the knowledge of the anatomy and the loca-believe, in general, only a physician has suffi- this beam of rays toward the disease and we Considerable skill is necessary in directing the irradiation effect as much as possible 2 or 4 milliamperes of current, so as to prolong tance of 50 centimeters, making use either of filtration or its equivalent, usually at a dis- volts, constant potential, 2 millimeters copper results. We utilize for this purpose 200 kilo- tissues, and will accomplish probably the best daily, we will do less damage to the overlying 200 to 250 r (roentgens) daily, or 150 twice crossfiring on the disease, and by delivering entry as is possible which will permit accurate to the patient through as many portals of tissues. We therefore plan to give treatment permanent damage to the patient's normal 2 To accomplish this without serious or delivered into the tumor area will require from 3,000 to 6,000 r (roentgens) 1 To deliver enough irradiation into the tumor tissue to destroy the cancer cells. This

be borne in mind that the more sensitive types of tumor are also the group that are apt to give rise to metastasis, and one is apt to fail from metastatic involvement even though success has followed the local treatment.

Cystitis is apt to be a complication before, during, and after the roentgen treatment and must be dealt with just as cystitis would be treated under any other conditions. Anemia must be counteracted.

We aim to give the planned treatment within a period of a month, which means from 20 to 25 treatments, but this number of treatments may have to be doubled or tripled. It is our aim to give as little treatment as will accomplish the results. The more accurately the disease is localized and the smaller the extent of the disease, the smaller will be the portals through which the irradiation is given, and the more one can conserve the normal tissues. On the other hand, if one confines the treatment to too small an area, some remnant of the disease will be missed and recurrence will follow. Careful investigation and keen clinical judgment is necessary. Too few patients have been treated to make statistics of any value. For the present, the striking results obtained in individual cases seem to be convincing, as to the value of the treatment.

#### CONCLUSIONS

1 Since only about one fourth of the patients with carcinoma of the bladder can be treated surgically without interference with the urethra or ureters, therefore, three fourths of the cases should be treated by irradiation.

2 Highly filtered high voltage roentgen treatment seems to accomplish more satisfactory results than other methods, especially in the inoperable group.

3 The treatment involves less suffering and less interference with the daily habits than any other form of treatment.

4 Insufficient cases have been treated by this method to make statistics of any value, but my impression would be that we may expect disappearance of the tumor in from 30 to 50 per cent of cases.

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# GLUCOSE TOLERANCE AS A DIAGNOSTIC AID IN JAUNDICE

## II Further Differentiation of Cases Showing an Obstructive Type of Curve

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It was pointed out that in cases of jaundice the blood sugar curve following the ingestion of 100 grams of glucose, conforms to certain type reactions which, if properly interpreted, might help in differentiating between toxic and obstructive jaundice. The obstructive curve is characterized by a rise in the blood sugar which fails to return to normal at the end of the 2 hour period. This curve in its various modifications was obtained in those cases of obstructive jaundice due to

calculi, stricture or suppurative of the common duct, and carcinoma of the head of the pancreas or ducts. It was also obtained, however, in those jaundice cases included in the so-called intrinsic hepatic group, as cirrhosis, liver abscess, and primary or secondary carcinoma, infiltration of the organ. In continuing these studies it was felt that a great deal of additional benefit could be obtained if one could have some means of separating these so called pure obstructive cases of jaundice from those due to intrinsic disease.

The procedure which we have found helpful in making such a distinction was discovered in the course of treatment of cases of cirrhosis associated with jaundice. It was noted in these cases that the icterus would gradually clear when these patients were put on the following therapeutic regimen: (1) high intramuscular injections of liver extract, (2) 10 units of insulin, twice a day, (3) high carbohydrate feeding. Further studies were then made in order to utilize this therapeutic response in differentiating these various cases of jaundice.

### OBSERVATIONS

It was found that with this procedure, patients with jaundice due to benign fibrosis of the liver showed (1) a gradual decrease in the jaundice as measured by the icterus index, (2) the sugar tolerance curve changes from an obstructive type at the beginning of the period to a non-obstructive type at the end of the period. Such changes as these do not occur in the malignant involvement of the liver or in the case of obstruction of the common duct. These observations may perhaps be made much clearer by the following case reports.

### CASE 1 Patient M. C. H. N. 28899 Male, age 56 years, was admitted to the hospital June 16, 1936

He had been confined to his bed for 1 week prior to admission with severe attacks of abdominal cramps and vomiting. His druggist prescribed for him and he was able to go to work 4 days ago, but could only stay there for a few hours and then had to return home. His family noticed that he was distinctly jaundiced. The severe abdominal pain and vomiting persisted and admission to the hospital was advised by the local physician. The patient's past history revealed that he was a very heavy drinker and had been in the habit of consuming about 20 to 30 glasses of beer and a quart of whiskey for the past 25 years.

From the Medical Service of Dr. A. L. Garbner, Lenox Hill Hospital, New York City. Received for publication May 1, 1937.

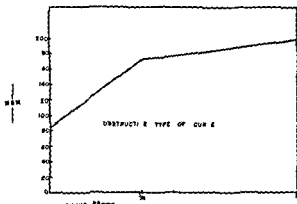


Fig 1 Sugar tolerance curve of M.C. aged 56. Histological No 28899 June 15, 1936 Icterus index 60

Six years previously he had been admitted to our hospital for an erysipelas infection of the face which responded to treatment.

Examination of the patient at the time of admission revealed a well developed and well nourished 56 year old male who was mentally confused. His temperature was 101 degrees, pulse, 80, respiration, 26 and blood pressure, 130/74. The patient was jaundiced and there was slight cyanosis of the lips and finger nail beds but no dyspnea. There was a marked arcus senilis present. The pupils reacted normally to light and accommodation. The chest was emphysematous in appearance and rales were present at both bases. The heart was enlarged. The abdomen was distended and the liver enlarged to about four finger breadths below the costal margin with some tenderness and muscle spasm in the right upper quadrant. Both extremities showed pitting edema and absence of knee jerks. Icterus index on the day of admission was 60 and the sugar tolerance curve showed an obstructive type of reaction as shown in Figure 1. Fasting blood specimen was 84 milligrams of blood sugar per 100 cubic centimeters of blood. The 45 minute figure was 173 milligrams

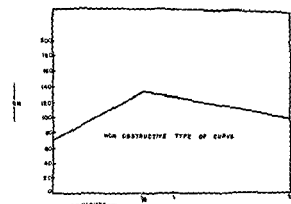


Fig 2 Same case as in Figure 1, June 25, 1936 Icterus index, 16

per 100 cubic centimeters of blood and the 2 hour specimen 200 milligrams per 100 cubic centimeters of blood. The patient received daily intramuscular injections of a 3 cubic centimeters ampul of liver extract and a high carbohydrate diet with 250 grams of glucose and insulin, 10 units twice a day. By June 25, 1936, patient showed a marked improvement. He was mentally alert and more co-operative. The icterus index had dropped to 16 and the glucose tolerance test showed a complete change from the obstructive to the non-obstructive type as shown in Figure 2. The fasting specimen was 73 milligrams sugar per 100 cubic centimeters of blood. The 45 minute specimen showed 133 milligrams per 100 cubic centimeters of blood and the 2 hour specimen was 200 milligrams sugar per 100 cubic centimeters of blood. The patient continued to show this marked improvement so that by July 2, 1936, he was able to be up and about.

CASE 2 Patient F.H.H.N. 52872 Male, age 56 years was referred to the hospital on June 15, 1936 from the cardiac clinic where he had been in attendance since September 16, 1935. His symptoms of decreased cardiac reserve dated back about 2 years.

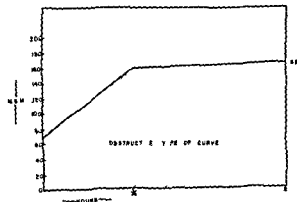


Fig 3 Sugar tolerance curve of F.H. aged 56. Histological No 52872 June 23, 1936 Icterus index 16



Fig 4 Same case as in Figure 3 July 10, 1936 Icterus index 29

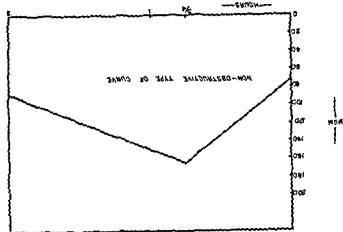


Fig. 6 Same case as in Figure 5, September 11, 1936. Icterus index, 50.

For 1 year prior to admission patient had been having intermittent attacks of indigestion and last April, two of these were accompanied by severe pain in the right lumbar region which radiated to the right costal border. Two months ago patient noticed itching and 3 weeks ago she noticed that she was jaundiced. These symptoms have steadily increased. The onset of the present symptoms were not associated with any attacks of pain, and this was the first time that the patient noticed that she was jaundiced. There had been no vomiting and her bowels were constipated, for which she was taking saline cathartics. Patient stated that she did not notice any relation between her meals or fat intake and the attacks of indigestion. She also stated that as a child she had had attacks of indigestion which were diagnosed as due to "liver trouble." She was married and had been through two normal pregnancies. There were no other significant facts in her history.

Examination revealed a well developed and nourished female, markedly jaundiced and showing numerous scratch marks as evidence of her itching. The heart and lungs were normal. The abdomen Fig. 7 Icterus index curve on same case as in Figures 5 and 6.

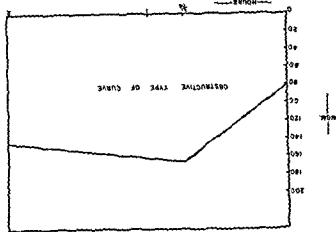


Fig. 5 Sugar tolerance curve on C M, aged 40. Histological No 53604, August 3, 1936. Icterus index, 100.

For 6 weeks prior to admission he had been receiving 4½ grains digitalis, every day, 3 cubic centimeters of mecumperin every week, and 5 grains of theocin four times a day, together with bed rest at home. During this period he gained 14 pounds without any improvement in his general condition.

On admission to the hospital his temperature was 99.6 degrees, respiration 28, pulse irregular with a pulse deficit of four, blood pressure, 130/100. The patient showed all the signs of congestive failure secondary to an auricular fibrillation with dyspnea and cyanosis, rales at both bases, and marked ascites and peripheral edema. Abdominal paracentesis yielded 5,000 cubic centimeters of opaque amber colored fluid. On June 18, 1936, the icterus index was 16. The jaundice at that time was considered on the basis of a chronic passive congestion of the liver secondary to a cardiac decompensation. Intensive measures to combat the cardiac decompensation showed some signs of improvement but in spite of this the patient's icterus index increased to 29. A sugar tolerance test performed on June 23, 1936 showed a typical obstructive curve (Fig. 3) with fasting blood sugar of 70 milligrams per 100 cubic centimeters of blood. The 45 minute specimen was 160 milligrams and the 2 hour specimen 166 milligrams per 100 cubic centimeters of blood. The patient received 3 cubic centimeters of liver extract daily with high carbohydrate diet. On July 10, 1936, the sugar tolerance test still showed the presence of an obstructive curve (Fig. 4), with fasting specimen, 95 milligrams per 100 cubic centimeters of blood, 45 minute specimen, 180 milligrams, and 2 hour specimen 182 milligrams per 100 cubic centimeters of blood. A diagnosis was therefore made of carcinoma of the liver. The patient continued to grow progressively worse, and died on July 10, 1936. An autopsy was performed which showed the presence of a primary carcinoma of the liver.

Case 3 Patient, C M, H N 53604. Female 40 years of age, admitted to the hospital July 31, 1936.

was slightly full and the liver palpable below the costal margin. There was some tenderness in the right upper quadrant. There was no temperature. Attempts to visualize the gall bladder with the dye were unsuccessful. The icterus index, August 1, 1936 was 100 and the sugar tolerance curve, August 3, 1936 (Fig 5), showed an obstructive curve with the fasting specimen 80 milligrams 45 minutes 166 milligrams and 2 hours 141 milligrams. The majority of the opinions expressed at the time seemed to favor the diagnosis of obstructive jaundice due to stone in the common duct. The picture however, was not quite clear cut and on August 6, 1936 the patient was started on liver extract intramuscularly, together with 250 grams of glucose and 20 units of insulin daily. The course of the icterus index in this case during the period of treatment is shown in Figure 7. On September 10, 1936, the icterus index had decreased to 50 and the sugar tolerance curve (Fig 6) performed the next day showed a change from the obstructive type mentioned above to a non-obstructive type. The fasting blood sugar was 74 milligrams the 45 minute specimen was 143 milligrams and 2 hours was 90 milligrams. The patient seemed so much improved that it was decided to see what she would do without the liver glucose and insulin. One week later the icterus index was repeated September 17, 1936 and found to be practically unchanged at 52. The therapy was then resumed on September 22 and on October 5 the icterus index had dropped to 39. The patient insisted upon going home and there continue with her treatment. A follow up determination of her icterus index on October 14, 1936 showed a further drop to 29.0 and the patient showing marked improvement in her general condition.

These representative cases demonstrate clearly the response obtained in disturbed structural changes of the liver to the administration of liver extract, insulin, and glucose over a period of at least 2 or 3 weeks. All 3 cases showed the presence of jaundice with an obstructive type of sugar tolerance curve at the time of admission to the hospital. The first case showed at the end of the 2 week period a change in the sugar tolerance curve to the non-obstructive type with a decrease in the degree of icterus. This reaction has been obtained thus far only in cases of jaundice associated with cirrhosis or benign fibrosis of the liver. In Case 2, no such change or reversal of the sugar tolerance curve took place. Both at the beginning and end of the period of treatment with liver extract, insulin, and glucose, the sugar tolerance curve remained of the obstructive form. This fact together with the history and clinical course prompted

us to classify this case as one of carcinomatous infiltration of the liver. Our opinion was confirmed by necropsy findings. In the third case the clinical picture could very well be interpreted as one of jaundice due to calculus obstruction. In fact that was the opinion expressed by several of the physicians who studied the case. The presence of an obstructive type of sugar tolerance test obtained at the time of admission could be consistent with both calculus obstruction and disturbed structural changes of the liver. It was certainly advisable to delay operation for a while in order to make this differential. After a 3 week period the icterus index decreased from 100 to 50 and the sugar tolerance curve changed to a non-obstructive type. The patient continued to improve and at the time of her discharge her icterus index had decreased to 39. A follow up, 9 days after discharge showed an icterus index of 29. The height of the icterus index is apparently of no assistance in differentiating between these conditions.

It must also be mentioned that the possibility always exists of both calculus formation and structural liver damage occurring in the same case. Our further work may add additional observations on this point. Where the differential diagnosis to be made happens to be between calculus obstruction and carcinoma of the liver, the above procedure is of no help since in both conditions neither the degree of icterus nor the type of sugar tolerance curve is effected by the liver extract, glucose and insulin therapy. The obstructive sugar tolerance curve obtained in both the calculus obstruction and carcinoma of the liver cases would necessarily indicate surgical intervention. There is so little to be lost, however, by operating on such a hopeless condition as carcinoma of the liver that this possibility can hardly be considered as a serious drawback, when compared with the useful information which the above differential procedure affords.

#### CONCLUSIONS

1. Cases of jaundice which give the so called obstructive type of sugar tolerance test can be further classified



## THE FALLACY OF THE USE OF IODINE IMMEDIATELY AFTER BILATERAL SUBTOTAL THYROIDECTOMY

### A Preliminary Report

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In cases of benign structural damage of the liver as cirrhosis, the daily use of liver extract, 250 grams of glucose and 20 units of insulin, results in a gradual decrease in the fundic and a change in the sugar tolerance

curve from "obstructive" to "non-obstructive" 3 This same response is not obtained in carcinoma of the liver, or in obstructive lesions of the common duct

THE dramatic demonstration of the use of iodine in exophthalmic goiter by Plummer in 1923 was an epoch in the surgical treatment of toxic

goiter. The rapid improvement in the condition of these patients when treated by iodine, and the comparative safety with which they may be operated upon, has greatly widened the field of thyroid surgery, but, as in other

progressive steps in medicine, its use has in some hands become indiscriminate and empirical.

It has been the opinion of one of us (M. D.) that the use of iodine after operation in patients who have had proper preoperative iodination was an unnecessary procedure.

Nothing in the experimental or clinical literature has shown any chemical or physiological reaction between iodine in any form and thyroxine, once the thyroxine has reached the circulating blood stream. Conversely it is an established belief that the improvement in toxic patients is due to a diminution in the amount of thyroxine allowed to escape from the gland.

If this be true, the use of iodine in the immediate postoperative course of the patient following bilateral subtotal thyroidectomy has no therapeutic foundation and is an unnecessary

experiment. With these ideas as a basis, the following experiments were carried out:

One hundred consecutive patients with hyperthyroidism, irrespective of type, were taken from the medical services of the Cook County Hospital and the University Hospital

for the Department of Surgery, Northwestern University, and the Surgical Service of the Marshall DAVISON at Cook County Hospital and the University Hospital.

From the Department of Surgery, Northwestern University, and the Surgical Service of the Marshall DAVISON at Cook County Hospital and the University Hospital.

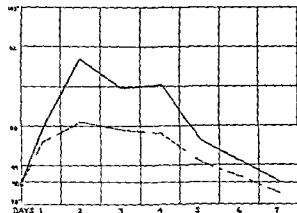


Chart 1 The unbroken line represents the highest daily postoperative average temperature of the 50 patients in series A (receiving iodine). The broken line represents the average daily lowest temperature in this series.

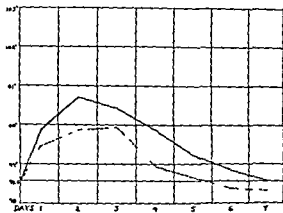


Chart 2 The unbroken line represents the highest daily postoperative average temperature of the 50 patients in series B (receiving no iodine). The broken line represents the average daily lowest temperature in this series.

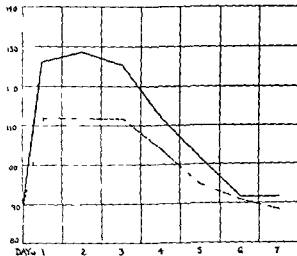


Chart 3 The unbroken line represents the average highest daily postoperative pulse rate of the 50 patients in series A. The broken line represents the average lowest daily pulse rate in this series.

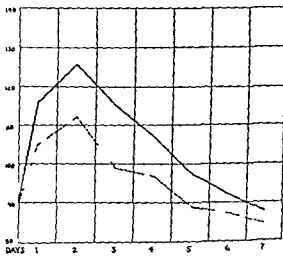


Chart 4 The unbroken line represents the average highest daily postoperative pulse rate of the 50 patients in series B (receiving no iodine). The broken line represents the average lowest daily pulse rate in this series.

TABLE I—SUMMARY

	Series A	Series B
Average highest basal metabolism rate	39.7	43.9
Average lowest basal metabolism rate	20.9	18.0
Average days on Lugol's	17.6	18.5
Average age	40.1	38.5

after having been carefully prepared by iodization and supportive treatment.

In all of these patients the classical operation of bilateral subtotal thyroidectomy was done in one stage.

Fifty patients comprising series A were given Lugol's solution after operation as in

the usual procedure, rectally in a dosage of 1 dram immediately upon the return from the operating room, and from that day on by the oral administration of 10 minims three times daily. This amount is greatly in excess of that required for iodization. A second group of 50 patients, comprising series B, were given no iodine in any form after operation. Other than this exception—the routine postoperative treatment was exactly the same as used in series A, consisting of a minimal amount of 2000 cubic centimeters of 10 per cent glucose given intravenously in

# CONCLUSIONS

It would seem from this comparable series of cases that the following conclusions may be drawn

- 1 Patients in series B to whom iodine was not administered after operation had an average milder reaction than those in series A who were given iodine
- 2 Patients in series A who developed post-operative toxic phenomena did not seem to be influenced any more rapidly by the use of iodine, whether given intravenously or by mouth, than those of series B who were not given iodine
- 3 From the above facts it would seem that the proper attack upon untoward reactions following bilateral subtotal thyroidectomy is dilution of the thyroxine in the circulating blood stream by the administration of enteral or parenteral fluids
- 4 Toxic reactions must be proportional to the degree of pre-operative preparation of the patient, and consequently to the amount of thyroxine delivered into the blood stream at the time of operation
- 5 There is no combination clinically shown to exist between iodine and thyroxine in the circulating blood
- 6 If sufficient gland has been removed, and before operation, the use of postoperative iodine seems to have no rational basis
- 7 In consideration of these factors the use of iodine is still definitely indicated in such incomplete operations as polar ligations, lobectomy, and the removal of discrete adenomas, in all of which cases residual thyroid tissue has been left behind, necessitating further protective iodimization

each 24 hours for 2 days, and morphine grain  $\frac{1}{2}$  administered as was found necessary for restlessness

The postoperative course of both series was judged by the temperature, pulse, respiration, and the general toxicity of the patient, on the basis of 1 to 4 plus. The average highest and lowest daily temperatures were plotted (Charts 1 and 2). The average high and low pulse rates for each day were charted in a like manner (Charts 3 and 4). Further to compare the two series, the average basal metabolism rates on entrance and after preparation, as well as the number of days on iodine are recorded. The age of these patients ranged from 16 to 63 years in each series (Table I). As may be seen from the above charts the 2 series are fairly comparable as to average original metabolic rate, average reduction in the rate following the preparation with iodine, and the average number of days necessary to accomplish the optimum pre-operative improvement. We were prepared at all times to sodium iodine to any patient whose reaction seemed unduly severe, but in no case did this become necessary. Even in instances in which the temperature and pulse rate rose disproportionately the administration of continuous intravenous glucose, by dilution produced a steady fall in the temperature and pulse and a general steady improvement in the toxic reaction of these patients. Those patients in series A who developed equally high temperature and rapid pulse rates did not respond any more rapidly to iodine and intravenous glucose than did those patients in series B who were given glucose solution only

# ARTIFICIALLY INDUCED THROMBOPHLEBITIS

## With a Suggested New Approach to the Problem of Postoperative Pulmonary Embolism

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THE problem of pulmonary embolism may be attacked from two aspects, the prophylactic and the curative. The cure of a case of pulmonary embolism by operative removal of the thrombus from the pulmonary artery furnishes probably the most dramatic triumph of the mechanical art of surgery. But the main problem it hardly touches. On the other hand our knowledge of the factors determining the development of postoperative thrombosis is still too rudimentary to enable adequate prophylactic measures to be adopted to prevent such thrombosis. It is true that something can be done, the most hopeful line of approach up to the present being the encouragement of measures to prevent venous stasis. But pulmonary embolism still occurs. In this situation it seemed to me that a new approach to the problem might be tried. And briefly the approach I would suggest is to recognize that in the present state of our knowledge it is impossible to prevent postoperative thrombosis, but to try to ensure that, should such thrombosis develop, the thrombus will remain fixed at its site of formation and not migrate. Then, though it may cause annoying sequelae, they will not be tragic ones.

Generally speaking, the thromboses that occur after operation may be divided into two groups: those in which the phlebitic element is marked, and in these the signs are essentially obstructive, such as swelling of the leg and dilatation of collateral veins; and those in which the phlebitic element is not marked, and in these the first sign that a clot is present is often its migration. Now some light is thrown on the nature of the phlebitic element of thrombophlebitis by the changes that take place when a so-called sclerosing solution is injected into a vein as in the treatment of

varicose veins. It is, of course, well known that in a positive case two things happen: the vein lumen becomes filled with clot, and inflammatory changes take place in the vein wall and the surrounding connective tissues. There is thus the complete thrombophlebitic picture similar to that of the spontaneously arising condition. The reason for the production of the thrombus in the vein lumen under these conditions seems quite clear, the sclerosing fluid damages the vein wall and liberates a coagulating agent. The phlebitis at first sight is explicable in a similar way, as a direct reaction to the damage done to the vein wall by the sclerosing fluid. But while this no doubt plays a part in the inflammatory reaction there are certain observations which make it unlikely that this is the whole story, or even the major part of the story.

For example, Figure 1 represents, diagrammatically, two common parallel observations. Figure 1, a, represents a large varicose vein with a marked regurgitant flow from above. If this vein is injected and the injection takes, the distended vein becomes filled with a large amount of thrombus and the phlebitic element is always marked. If the case is first treated, however, by proximal ligation to prevent regurgitant flow (as in Figure 1, b) the lumen of the vein is much smaller, the size of the thrombus is therefore much smaller, and corresponding with this the amount of inflammatory reaction in and around the vein wall is found to be much less marked. This is so in spite of the fact that in the type of case shown in Figure 1, b, the amount of sclerosing fluid injected is usually much greater than in the type of case illustrated by Figure 1, a. In other words, the phlebitic element is proportionate to the degree of distention of the vein in which thrombosis occurs and not to the amount of thrombotic agent injected.

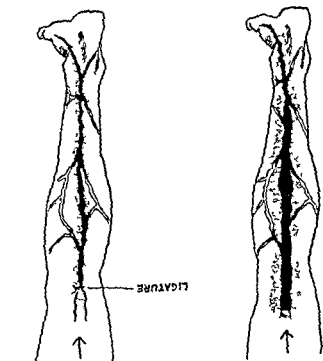


Fig. 1 A left Represents a varicose internal saphenous system with a marked superior reflux. Thrombosis occurs

(and corresponding with this the inflammatory reaction after injection in this case will be in a distended vein and around the vein wall will be marked by suppuration in and around the vein wall. Thrombosis therefore occurs in an undistended vein and the inflammatory reaction will be much less marked.

Figure 2 represents, diagrammatically, another common observation. If in a case of complete internal saphenous varicosity a ligature is tied around the vein about its middle, and an injection is made into the part peripheral to the ligature, thrombosis occurs in the distal part of the vein, and corresponding with the fact that the vein is collapsed from the cutting off of the regurgitant flow, the inflammatory reaction is slight. Frequently, however, thrombosis also occurs in the stagnant column of blood above the ligature into which no injection has been made. This part of the vein is dilated, since the regurgitant flow from above has not been cut off. The thrombus is therefore a large one, and corresponding with this the phlebotic element is marked, much more marked than in the case of the distal collapsed thrombosed vein into which the injection has been made.

Finally, if treatment has been by a ligature and injection and the patient is allowed to stay in bed afterward, sometimes when he

Fig. 2 This represents a similar internal saphenous system with a marked superior reflux. Ligature at the point indicated and injection peripherally will be followed by thrombosis with moderate phlebitis. If, however, soon above the ligature into which no injection has been made, the inflammatory reaction will be much more marked.

gets up blood regurgitates through collateral channels into tributaries of the varicose system which have not been obliterated, and forms dilated pools, and if thrombosis occurs in these dilated pools the phlebotic element is more marked than in the main vein thrombosed in a collapsed condition.

The deduction from these observations would appear to be that the amount of phlebotic reaction is chiefly proportionate to the degree of dilatation of the vein in which thrombosis occurs and not to the amount of thrombosing agent injected.

If we now apply these facts to the problem of pulmonary embolism, clinical evidence already mentioned suggests that the phlebotic element in thrombophlebitis acts as a preventive of pulmonary embolism, if we exclude the frankly septic thrombus, thrombi with a

marked phlebitic element rarely migrate. And since at present we cannot control or prevent the development of postoperative thrombosis, it would seem that another possible approach is to try to ensure that if thrombosis does occur, the protective phlebitic element is as marked as possible. If it be true that the amount of phlebitis is proportionate to the degree of dilatation of the vein in which thrombosis occurs, then our object should be to keep the veins of the lower limb, the usual source of postoperative pulmonary emboli, as dilated as possible. This can be achieved quite simply by raising the head end of the bed after operation and thus ensuring that the legs are the most dependent part of the body, when gravity will keep them filled.

There are two possible objections to this course. In the first place, it might be argued that a shocked patient would not be able to stand the head end of the bed being raised, and that in any case it is undesirable that a patient should be put into this position immediately after a severe operation. There is force in this argument, and on general principles it would appear advisable not to adopt a routine raising of the head end of the bed until 12 to 24 hours after operation. Second, it might be argued that placing the lower limbs in a dependent position would cause venous stasis, a known predisposing factor in thrombosis. If, however, a hard pillow is placed below the feet, the patient automati-

cally tends to press against it in order to counteract the tendency to slip down the bed. And the resulting tonic action of the muscles probably more than counterbalances any stasis induced by gravity. In actual fact, experience of treating patients in this position after operation during the past year has revealed no serious practical objection.

#### SUMMARY

Experience of thrombophlebitis induced by sclerosing agents shows that the phlebitic reaction in thrombophlebitis is proportionate to the degree of distention of the vein in which it occurs. Experience of spontaneously occurring thrombophlebitis, on the other hand, shows that a marked phlebitic reaction is a protection against the thrombus migrating. Since we cannot control the development of postoperative thrombosis, therefore, we should try to ensure that it takes the less virulent local obstructive form rather than the migrating embolic form. It is suggested that this might be achieved by raising the head end of the bed 6 to 9 inches as a routine after those operations on adults which are particularly likely to be followed by pulmonary embolism, and keeping it raised until convalescence. In view of the blank walls reached in other directions in the attempted prophylaxis of pulmonary embolism, the carrying out of this simple measure on a large scale would be a legitimate clinical experiment.

# THE CLOSTRIDIUM WELCHII AND ASSOCIATED ORGANISMS

## A Review and Report of 43 New Cases

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Clostridium oedematis maligni and Clostridium novyi were also found in an appreciable percentage of cases. However, in civil life the incidence of these organisms is much less frequent. In the 139 instances where the organism is reported in the collected cases, the Clostridium welchii was present 132 times, Clostridium oedematis maligni and Clostridium novyi 4 and 3 times, respectively. Whether this is the true status or whether cases occur in which thorough bacteriological investigation is not the rule is a debatable question.

The Clostridium welchii is a gram positive spore forming anaerobe. Though it will not grow in the presence of free oxygen this organism and Clostridium enteridis sporogenes are two of the less strict anaerobes. The presence of a capsule is a distinguishing feature. It causes foamy fermentation of litmus milk and grows best in a slightly alkaline medium, although producing acid itself. In culture there is a tendency to die out unless there is present an excess of alkali, such as calcium. Gas gangrene can be produced experimentally in mice, guinea pigs, and rabbits. They are highly resistant, however, if calcium is included in the injected cultures.

The desirability of rapid means of identification is self evident. In order to accomplish this some authors have suggested the injection into animals (mice and rabbits), sacrificing the animals after 30 minutes and incubating for 6 hours. The danger of false positives is quite apparent when one realizes the wide distribution of this organism in nature. Cultures from the battle field of France, as well as from the uniforms returning from the trenches were 100 per cent positive. Cultures taken from war wounds in the year 1916 were reported 81 per cent positive. Even after the

SINCE the World War and especially during the last 5 years, surgeons have published many articles relating their clinical experience with gas gangrene. In addition, the Clostridium welchii has been the subject of numerous investigations. The mass of information thus accumulated has not been thoroughly reviewed, it seemed worthwhile to survey these data and summarize them briefly. In addition, a statistical analysis of 349 cases reported from 1930 to 1936 is included. This period was chosen because Millar already collected the 607 cases reported from the beginning of the post-lister period to 1930, again it was felt that by limiting the cases to those of the last 6 years, one should obtain a more accurate impression of the subject of gas gangrene as it exists today, perhaps influenced by modern high speed transportation and industrial machinery. Finally, 43 additional cases are reported from the University of Pennsylvania and Philadelphia General Hospitals.

## BACTERIOLOGY

The most common etiological organism in gas gangrene is the Clostridium welchii. There have been at least 25 varieties of anaerobic organisms isolated. Three of these are the common ones. From 80 to 90 per cent are the Clostridium welchii, at times termed the Clostridium oedematis, Bacillus aerogenes capsulatus, Bacillus perfringens, and Bacillus phlegmonosus. The Clostridium oedematis is a malignant or Vibrio septique comprises from 10 to 28 per cent whereas the Clostridium novyi often spoken of as Bacillus oedematis or Bacillus bellonensis accounts for only 5 to 35 per cent. Much less commonly the Clostridium histolyticum, Bacillus sporogenes, Bacillus proteus and Bacillus fallax are encountered. During the World War the

wounds had passed through a casualty clearing station the report was 23 per cent positive. In civil life chronic leg ulcers have shown 34.3 per cent positive, normal intact skin 7.6 per cent positive, and some writers state that it is a normal inhabitant of the human and animal intestinal tract.

It has been isolated from samples of milk, water (spring), shell fish, cheese, flour, wheat, barley, rice, oatmeal, gunwads, wool, air, canned sausages, lettuce, potatoes, rice pudding etc.

It has been cultured from the mouths of newborn infants, normal salivary glands, pancreas, normal urine and the vagina, and from the circulating blood in puerperal sepsis, chorea, and typhoid fever as well as in other diseases in which injury of the intestinal mucosa occurs.

Some investigators have even stated that the injection of sterile saline solution under these conditions will give positive results after incubation. The almost universal incidence of the organism makes a purely bacteriological diagnosis of gas gangrene unreliable. For example, Roberts, Johnson, and Brickner were able to cultivate it from the skin of 21.7 per cent of unprepared abdomens, 8.5 per cent of knife blades used in making skin incisions, and in 9.2 per cent in the peritoneum when opened for non-inflammatory conditions. One sees, therefore, that the finding of the Welch bacillus *per se* is meaningless. It is very important to bear this fact in mind when diagnosing gas gangrene and in comparing results obtained in their presence.

#### PATHOLOGY OF GAS GANGRENE

In the gas phlegmons or gas edema, the musculature is much involved, although other tissues, such as subcutaneous fat, are not absolutely immune. This is especially true if the vital forces are at a low ebb as result of shock or debilitating disease. The muscles are saturated with gas bubbles (carbon dioxide from the muscle glycogen), become discolored, then necrotic, soft and waxy with laminated destruction, then soft and fluid, until finally they become a pulp filled with gas bubbles. There may be combined with this an edema of varying degree in the interstitial tissue

which becomes cloudy and, following hemolysis, red in color, microscopically there are innumerable bacilli, fibrin, and leucocytes in the edematous mass. When a thigh is the site of gas edema, the swollen, pale skin feels cold to the touch and if the musculature is cut through crepitation is noted. This is a decomposition necrosis, the gases (carbon dioxide) arise from the action of the gas bacilli on the necrotic tissue. When pieces of earth infected with various anaerobic organisms and spores of many other kinds of bacteria are carried into the tissues, it is not surprising that a mixed infection appears, in which pathogenic anaerobes of various kinds mingle with saprophytic decomposition organisms and pyogenic bacteria. This accounts for the varying pictures that of a markedly phlegmonous suppurative process with or without decomposition, or a predominant edema or a non putrid necrosis with gas formation without odor or foul decomposition with foul smelling gas formation. The differences are expressed in the nomenclature so frequently used, such as gas edema, gas phlegmons, gas gangrene, etc.

The important single factor in the production of gas gangrene is not contamination with the organism *per se* but rather a suitable soil in which it can grow. Deeply lacerated and contused wounds, hematomas and compound fractures offer particularly favorable sites for the development of gas gangrene. Devitalized tissue and absence of oxygen favor rapid growth of the gas bacilli. The destruction of blood supply to a part, whether by trauma or occlusion, i. e., diabetic gangrene, affords ideal conditions.<sup>1</sup>

The path for spread of the infection follows muscle bundles. The muscle first loses its staining reaction and completely degenerates ultimately. Such destruction of tissue precludes actual invasion of the tissue by the organism. The swelling of fibers within the muscle sheath strangulates it and furnishes the ideal environment for the growth of the Welch bacillus. Though muscle is the tissue most commonly involved in the gas phlegmon, other tissues, such as subcutaneous fat, are

<sup>1</sup>The above pathological description is almost a verbatim quotation from Kaufmann's Pathology, Reimann—vol. 31, p. 2042-2044.



TABLE I.—VALUE OF X-RAY IN EARLY DIAGNOSIS—FROM D. A. RHINEHART

Diagnosed clinically		Diagnosed by x ray	
19 Cases	17 Cases	12 Cases	18 Cases
Shortest time	12 0 hours	2 5 hours	12 0 hours
Average time	75 0 hours	52 5 hours	75 0 hours
Longest time	175 0 hours	128 8 hours	175 0 hours
Mortality per cent	50 5	52 5	18 2

Two hundred and twenty-two cases have been collected from 1930-1936. The reports in the East as well as in the West. The reports, current in the city as well as in rural districts, appearing from Australia, the Philippines, South Africa, Europe, South America, Canada, and practically every state in the Union.

Sixty-seven of these involved the upper extremity, with 10 deaths, 14 per cent, 33 of the 67 were treated by amputation, with 3 deaths, 9 per cent. This low mortality record is contrary to the opinion expressed by Miles who says that he never saw a case recover following amputation of the arm. The most frequent site of infection was the lower extremity in 106 cases with 25 deaths and 23 per cent mortality, 38 required amputation with 12 deaths, 31 per cent.

The amount of contamination at the time of the trauma has a definite influence upon the likelihood of development of gas gangrene. Personal cleanliness must also be considered. This fact is substantiated by Boland's figures that one assumes that negroes are less cleanly than Caucasians. In Atlanta, in 80 cases of compound fractures occurring in negroes, 15, 19 per cent, developed gas gangrene, whereas in the same period, in 97 cases of compound fractures occurring in whites, 7 developed gas gangrene, 7.1 per cent. Another fact which may have some bearing is the delay following injury in consulting a physician, which was probably greater among the negroes. This point was clearly brought out during the World War when the incidence and mortality of gas gangrene was directly proportional to the time between trauma and debridement of the wound.

Many and varied types of trauma have been noted as predisposing factors. In one series of 222 there were 84 compound fractures, 43 automobile accidents, 26 industrial accidents and lesser numbers of gunshot wounds, splint

not absolutely immune. This is especially true if the vital forces are at a low ebb as result of shock or debilitating disease

#### DIAGNOSIS AND SYMPTOMATOLOGY

The diagnosis is not difficult in fully developed cases if the possibility of the condition is borne in mind. All individuals with severely contused wounds and compound fractures as well as those who have had amputations for diabetic gangrene, should be examined closely for evidence of gas bacillus infection. The characteristic "mousy odor," *kakai discoloration* of the skin, brownish discharge, unexplained severe pain and pulse rise out of proportion to the temperature, are practically pathognomonic. If local crepitation is added to these symptoms, the diagnosis is established, though it should be confirmed by the bacteriological laboratory. The mental alterations of the individual should not make one too optimistic as this is often the case in extremis.

Early diagnosis is essential for low mortality. Considerable aid can often be obtained from the roentgenogram. Rhinehart (Table I) has clearly shown its advantage in making the diagnosis of gas gangrene before it is clinically apparent. In suspected cases roentgen examination every sixth hour has been recommended. The x-ray not only affords assistance in diagnosis but it will frequently show the extent of the disease and give the surgeon valuable aid in determining the surgical procedures required. This gas must be differentiated from air forced into the tissues by muscle action following an injury or occasionally from the use of hydrogen peroxide as an antiseptic. Such differentiation is possible, Saville states that one is able to differentiate the type of gas producing organism concerned. The presence of gas in the tissues from bacterial action, though usually due to one of the clostridium group, may, under favorable conditions, be caused by other organisms, especially the colon bacillus.

#### SUMMARIZED DATA FROM THE LITERATURE Influence of Trauma. The great proportion of gas gangrene followed accidental trauma

TABLE II—CASES FOLLOWING TRAUMA

Mortality per cent	Serum + x ray		Serum		No serum	
	19		17		31	
	Amputation	Incision	Amputation	Incision	Amputation	Incision
Recovered	8	25	34	60	22	17
Died	6	2	10	11	8	10
Mortality per cent	42	7	22	13	26	5
Percentage requiring amputation	34		35		41	

wounds and even insect bites. It is an interesting fact that only 7 of this entire group occurred on the farm.

One is immediately impressed with the large number of instances in which an automobile accident is the predisposing cause, which alone results in 4 times as many cases as gunshot wounds, in Millar's statistics gunshot wounds ranked ahead of vehicular as the means of entry of the organism. The histories in the 18 cases resulting from a fall from a height are strikingly similar, the usual story being a fracture due to indirect violence with a puncture wound near the site of fracture through which the bone might or might not protrude. The ends of the bone when examined were found to be contaminated by soil. Fractures were reduced and the first sign was severe pain. On removal of splints, the surgeon usually was surprised to find the arm swollen and a brownish fluid discharging from the puncture wound.

The type of treatment given these cases is summarized in Table II. All deaths reported are included in the mortality, whether from the toxemia of gas gangrene or some complication such as pneumonia, streptococcal septicemia, embolus, etc. All cases in which patients received serum are indicated thus whether the amount received was regarded adequate or not. Instances in which no mention of serum was made were considered as receiving none.

#### INFLUENCE OF HYPODERMICS

Junghaus (1933) analyzed more than 60 cases of gas gangrene following hypodermic

medication of all types of which only 4 survived. As a rule it was impossible to trace the gas bacillus to the hands of the administrator, nurse or doctor, skin of patient, needle, solution, or method of sterilization. In one instance it was traced to the solution, although only one individual developed gas gangrene in 5 or 6 injected. This again emphasizes the fact that in the absence of fertile soil the gas bacillus is relatively innocuous. The hypodermics contained various ingredients, i.e., caffeine, epinephrine, morphine, physiologic saline solution, etc. The most frequent site of injection was the thigh, 27 cases. There were 7 such cases in our collected series with 6 deaths, 3 had serum and the only recovery (hypodermoclysis under breast) was in this group. The sites of injection in this group were arm (2), thigh (3), and submammary region (2).

#### THE EYE AS AN ATRIUM

Walker (1934) collected 10 cases of panophthalmitis, all of which followed a foreign body and, peculiarly enough, all recovered. They were characterized by rapid onset of symptoms and severe pain. A bubble of gas could be seen on examination. They were treated by enucleation. Four cases have occurred between 1930-1936, only 1 patient receiving serum. The early recognition of the disease and the limitation to the eyeball probably accounts for recovery of all cases.

#### THE UTERUS AS AN ATRIUM

Patients affected following abortion or instrumental delivery show marked constitutional reaction. The patient is prostrated, with a rapid thready pulse and an extreme fall in systolic pressure. Restlessness and extreme pallor are noted. Toombs and Michelson reported jaundice in 50 per cent of the cases due to the intense hemolysis which more usually causes dusky purple suffusion of the skin. They found the red blood cell below 2,000,000 in 58 per cent of cases and hemoglobin below 60 per cent in 78.5 per cent of cases. A loss of 2,000,000 red blood cells in 24 hours is reported. A positive blood culture was present in 16 cases during life. In other types of infection due to the *Clostridium welchii* positive blood cultures are rare.

TABLE III—GAS GANGRENE FOLLOWING AMPUTATION CASES COLLECTED FROM LITERATURE 1930-1936—INCLUDING AUTHORS' CASES

Original cause for amputation	Serum used		% serum used				
	Dead	Mortality per cent	Alive	Dead	Mortality per cent	Alive	Mortality per cent
Diabetic gangrene	5	11	68	3	13	81	
Semile gangrene	4	4	50	1			
Buerger's disease	4		1				
Varicose ulcer							
Thrombosis	1		1				
Trost bite	3	1	33				
	16	17	51	5	14	73	

The Welch bacillus is probably present in a larger percentage of cases of puerperal sepsis than is generally recognized. Wrigley found 16 deaths from puerperal sepsis in St. Thomas Hospital, 6 with generalized gas gangrene as revealed by postmortem examination. Falls believes that in severe cases the infection is a mixed one, often associated with the streptococcus. Vaginal cultures in the prenatal clinic of the Research and Educational hospital were positive for *Clostridium welchii* in 48 per cent of cases, in the gynecological clinic, in 33 or per cent of cases, no positive results were found in a small series of private patients. In order to have a virulent infection, Wrigley presents the following four postulates:

- 1 Organism must be introduced into the uterus
- 2 Organism must find suitable (dead) material on which to grow
- 3 Dead fetus must remain sufficient length of time
- 4 Damaged maternal tissues must be exposed

From 1930-1936 there were 21 cases reported, 7 were treated with serum with 2 deaths, a mortality of 28 per cent. There were 7 deaths, mortality 46 per cent, in the remaining 15 cases treated without serum. Furthermore, of 8 recoveries, 6 were reported by Falls, the diagnoses having been based largely on the finding of the gas bacillus, the majority ran a mild clinical course. The question of exatipation of the uterus has arisen but too few cases have been reported to formulate any conclusions.

#### GAS GANGRENE FOLLOWING CLEAN AMPUTATIONS

In 1923, Tanner first reported gas gangrene following amputations through an allegedly clean field. Since 1930 there have been numerous similar reports (52 cases) which are summarized in Table III, 32, 61 per cent, have followed amputations for diabetic gangrene. The mortality is exceedingly high, being 59 per cent for entire group, still higher, 75 per cent, in diabetics. Table IV summarizes the experience with gas gangrene following amputations at the University of Pennsylvania and Philadelphia General Hospital. A commission was appointed to investigate this problem in New York City and the conclusions were published in the *Journal of Bone and Joint Surgery*. They suggested as the most likely means of infection inadequate preparation of the leg and the possibility of the *Clostridium welchii* being already present in the first several months after this procedure was instituted was nil.

Since then the rectum has been protected by a cotton filter and the incidence for the flatus passed following spinal anesthesia has been cultured the problem from this angle be the *Clostridium welchii* from years spinal anesthesia was almost the only anesthetic used. Attaching the problem from this angle be the *Clostridium welchii* from years spinal anesthesia was almost the only anesthetic used. Attaching the problem from this angle be the *Clostridium welchii* from years spinal anesthesia was almost the only anesthetic used.

TABLE IV—HOSPITAL STATISTICS

Philadelphia General

		Percentage
Total number of cases admitted to ward		
1930-1935	3019	
Major amputations required	283	9.3
Total Welch bacillus infection following amputation	19	6.7
Deaths in infected cases	14	73.0

University of Pennsylvania Services B and C

Total number amputations major (1923 to 1935)	Cases	Total
Diabetic	45	
Arteriosclerotic	12	
Buerger's	9	
Traumatic	7	
Embolus	5	
Frost bite	2	
Trophic	1	
Gas gangrene	2	81
Deaths		
Diabetic	15	
Arteriosclerotic	2	
Traumatic	1	21
Mortality		25%
Welch bacillus infection following amputations	0	
Percentage of post amputations infected	10 + 1/2%	
Mortality in infected cases	11 1/2%	

the lymphatics. It was thought unlikely that the gas bacillus was carried into the wound by any fault of the operating room technique or from suture material. The suggestions offered were (1) culture gangrenous area before operation and, if positive, give a prophylactic injection of serum, (2) culture muscle at site of amputation at time of operation, (3) guard against fecal contamination, (4) guard against exposing gangrenous area in the operating room, (5) never use a tourniquet, (6) guillotine type of operation preferable, (7) leave the stump open, (8) operate either at knee where few muscle bundles are exposed or mid thigh where one has good blood supply.

#### INCIDENCE FOLLOWING SURGICAL PROCEDURES

The complication of gas gangrene has followed almost every type of surgical procedure. In addition to those listed in Table V, cases have followed tonsillectomy, mastoidectomy, nephrectomy, and prostatectomy. The great proportion of these cases follow either gangrenous appendicitis and gangrenous cholecystitis or an operation in which the field is contaminated with fecal contents. The

usual site of infection is the tissue surrounding the incision. Probably in some of these cases the infection is terminal but in others the toxemia of actual gas gangrene is the direct cause of death.

Nason and Starr believe that it is a more frequent complication than is commonly thought stating that, "Failure to think of this complication and the consequent omission of pertinent bacteriological studies, may leave the surgeon mystified as to the actual cause of death." They believe that one should attempt identification of organisms in the following syndrome: "Within 6 to 12 hours after operation certain alarming signs may appear in a patient whose postoperative recovery has been proceeding satisfactorily. Blood pressure begins to drop slowly and steadily and pulse rate is accelerated correspondingly. The anxious, restless patient becomes semistuporous and finally lapses into coma. The skin and extremities are pallid, cold, and moist. Most striking phenomenon is the progressive increase in body temperature, reaching sometimes as high as 103 to 110 degrees F. The combination of very high fever and pale cold skin signified an extreme degree of peripheral vasoconstriction, but shock therapy produces little or no improvement. Death is similar to liver deaths of Heyd." These authors believe that this syndrome is due to the gas bacillus, although this has not yet been satisfactorily established.

In the 43 cases here reported from the Hospital of the University of Pennsylvania and the Philadelphia General Hospital 34 followed amputations of which 23 occurred in diabetic gangrene, 3 in senile gangrene, 2 in Buerger's disease, 2 following trauma, and 1 secondary to embolus. Compound fractures preceded 5 occurrences. Of the 4 remaining 1 occurred following operation for peptic ulcer, 1 after operation for gall bladder disease, and only 1 after a gunshot wound, another was secondary to a severe soft tissue contusion.

Seventy nine per cent of the cases seen in these 2 hospitals follow amputations through clean fields. This is not the experience in hospitals admitting a large number of industrial and automobile accidents, however



toxins (3) There is no evidence of the presence of the toxin of *Clostridium welchii* in the abdominal transudate or in blood from the mesenteric veins of dogs with acute intestinal obstruction (4) No direct or indirect evidence that toxin of *Clostridium welchii* has any rôle in the toxemia of acute intestinal obstruction

#### RELATION OF CLOSTRIDIUM WELCHII TO PERNICIOUS ANEMIA

An increase in the number of *Clostridium welchii* in the stools of patients with pernicious anemia and the marked anemia produced in acute infections of *Clostridium welchii* origin, suggested a possible relationship between *Clostridium welchii* and pernicious anemia. This, however, has been thoroughly disproved. Draper and Barach remark that anemia due to Welch bacillus toxin no matter how administered over how long a period, shows the characteristics of a secondary anemia. The hemoglobin is generally more lowered than the red blood cells, resulting in a low color index. The smear shows a conspicuous absence of nucleated red cells, marked distortion in the shape of the cells, and a predominance of macrocytes. Anisocytosis and polychromatophilia are the outstanding findings. The anemia tends to disappear spontaneously not withstanding the continued injection of toxin. The spinal cord does not show degenerative changes as seen in combined sclerosis and pernicious anemia. Immunity to the Welch toxin is quickly produced in the rabbit. They further state that "Sera of normal rabbits, normal individuals patients with secondary anemia did not possess anti hemolytic activity against Welch bacillus toxin. The series of pernicious anemia patients included instances of severe anemia as well as of remission." "The absence of specific Welch bacillus antihemotoxin in the pernicious anemia patients studied and its uniform presence in chronic Welch bacillus anemia in the rabbit suggests that these two anemias have a different etiologic mechanism."

#### RÉSUMÉ OF TREATMENT

Surgery is still the prime indication in most cases of gas gangrene, both as a prophylactic

and curative measure. Early debridement of contaminated wounds will protect many patients from the Welch bacillus. The fundamentals in the treatment of soiled wounds is adequately summarized in the outline to the United States Medical Corps before the Battle of Chateau Thierry. These instructions were to operate as soon as possible, to use nitrous oxide anesthesia, to employ longitudinal incisions half again as long as thought necessary, to avoid the use of tourniquets and injury to normal muscle, preserving all viable skin, to open wound thoroughly, all torn, crushed, and discolored muscle to be excised, all loose bone and foreign bodies to be removed, the wound to be left open, filled loosely with moist gauze and the part immobilized.

With the aid of serum more conservative surgery can and should be practised. A partially crippled leg or arm is better than an artificial one. There is one danger in recommending conservative surgery, viz where the blood supply to the part is destroyed. Traumatic cases of this type should be subjected to amputation without delay. One of the deaths in our series was attributed to failure to carry out this dictum.

Dakin's solution is the most popular of the antiseptics used. Its reaction is alkaline, however, and an occasional author will condemn it vigorously. With *Clostridium welchii* preferring a mild alkaline reaction a mild acid antiseptic might be better. Bulkey recommends the use of acetic acids. One wonders whether the hydrochloric acid in Pilcher's solution is not the active agent.

Some surgeons very strongly favor hydrogen peroxide while others oppose its use. It should logically be advantageous in creating an unfavorable growth medium. However, it has the possible advantage of forcing oxygen into the tissues which will confuse the attending physician in determining the progress of the disease. Potassium permanganate is another oxidizing agent very widely used. Some authors claim good results from bubbling oxygen through the wound. Others inject oxygen into the surrounding tissue to prevent spread, this also offers confusion in physical examination. The injection of foreign material proximal to the infected part might con-



Early diagnosis is essential in the treatment of gas gangrene

Serum therapy in addition to conservative surgery offers the best results. However, one should not hesitate to amputate in case of destruction of blood supply to an extremity. Although good results are reported from x ray therapy, one is not justified at present in omitting serum therapy. The need of good nursing care to prevent complications is emphasized and supportive measures especially blood transfusions, should not be neglected.

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# DIFFERENTIATION BETWEEN PERIPHERAL ARTERIAL AND ARTERIOLAR SPASTICITY IN THE SELECTION OF CASES FOR SYMPATHETIC GANGLIONECTOMY

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THE differentiation between organic and spastic vascular disturbances of the extremities is of great importance in outlining the course of treatment of those conditions. A number of methods have been devised to determine this difference and for the selection of cases for sympathetic ganglionectomy, namely, the vasomotor index of Brown determined by producing an artificial fever, anesthesia of the sympathetic nerves going to an extremity (10), anesthesia of the peripheral nerves (6), spinal anesthesia (1), and more recently the method of reflex vasodilatation of one extremity by warming another as devised by Landis and Gibbon (4).

Theoretically all cases of peripheral vasospasm should be relieved by sympathectomy. The occasional reports of failure to relieve those symptoms and the recurrence of symptoms in others after anatomically complete sympathectomy suggest the possibility that there are several types of peripheral vasospasm. In none of the aforementioned tests is there an attempt made to differentiate between vasospasm which involves central overstimulation of the sympathetic and that which may be due to local peripheral changes. To study these differences and to develop a method for their differentiation was the purpose of this investigation.

Our first problem was to determine the types of arteries dilated by the various known methods of testing vasospasticity. Other investigators have shown that any irritation of the skin, such as pinching or scratching, or the intradermal injection of histamine causes a dilatation of the surrounding vessels. In all experiments in this study the subject rested horizontally on a table for about one-half hour before the experiment was begun. The room temperature was between 20-22 degrees C. In a few instances when the room temperature was higher than 22 degrees C, all skin temperatures were corrected by subtracting 0.3 degrees C for each 1 degree C of room temperature difference (6).

## METHODS AND OBSERVATIONS

The method of determining vasodilatability by peripheral nerve anesthesia was first examined. In all experiments in this study the subject rested horizontally on a table for about one-half hour before the experiment was begun. The room temperature was between 20-22 degrees C. In a few instances when the room temperature was higher than 22 degrees C, all skin temperatures were corrected by subtracting 0.3 degrees C for each 1 degree C of room temperature difference (6).

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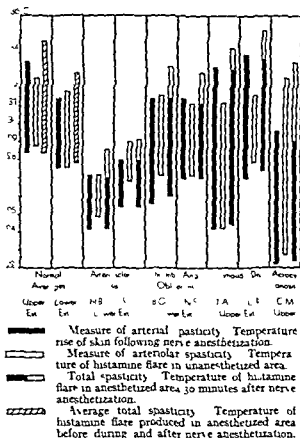


Fig. 1. Various combinations of arterial and arteriolar spasticity. Normal averages. Results in 3 normal brunet males. There is moderate arterial and arteriolar spasticity in both upper and lower extremities. Arteriosclerosis. Very slight arterial and arteriolar spasticity. Thrombo-angiitis obliterans. Moderate arterial and arteriolar spasticity. Raynaud's disease. Marked arterial and moderate arteriolar spasticity. Acrocyanosis. Moderate arterial and marked arteriolar spasticity.

The skin temperatures were taken with a mercury skin thermometer. The histamine skin test was performed in the extremities of normal individuals before simultaneously with, and at the height of the anesthesia produced in the tested skin areas. The temperatures of the histamine flares in these areas and in similarly situated unanesthetized control areas were recorded every 5 minutes. In the upper extremities the histamine skin tests were performed on the dorsum of the fifth finger and the skin was anesthetized by injecting 1 per cent procaine into the ulnar nerve at the elbow. A control histamine skin test was performed on the unanesthetized

dorsum of the first finger. In the lower extremities the tests were performed on the dorsum of the first toe, and anesthesia was produced by injecting 1 per cent procaine into the peroneal nerve below the knee, the posterior tibial nerve at the ankle and, when necessary, the saphenous nerve at the ankle.

A control histamine skin test was performed on the unanesthetized lateral surface of the foot. The results in three normal individuals in whom these tests were performed in both the upper and the lower extremities are shown in Figure 1 (normal averages).

In each instance the removal of the central vasomotor influences by anesthetization of the peripheral nerves leading to any area caused a rise in the temperature of that area with only a very slight redness of the skin. The histamine skin test performed in the same anesthetized area caused a comparatively intense red flare to appear at the height of the reaction and a further rise in skin temperature. The temperatures of the flares in the anesthetized areas were 1.0 to 1.5 degrees C higher than that of the surrounding skin, and 0.6 to 2.4 degrees C higher than that of a flare in an unanesthetized area. The results were the same regardless of the time relationship between the histamine skin test and the production of anesthesia.

The rise in the skin temperature with only slight skin redness following nerve anesthetization and the production of a comparatively intense red flare and a further rise in the temperature in the same skin areas by local irritation with histamine prove that complete vasodilatation is not produced by peripheral nerve anesthetization. These results suggest (1) that removal of the central vasomotor influences causes a rise in the skin temperature by dilatation of the larger terminal arteries, and (2) that local stimulation of skin by histamine causes a rise in the surface temperature by dilatation of the arterioles and capillaries.

In order to check this concept further similar experiments were carried out in normal individuals with different vasodilating tests. The tests included the following: anesthetization of the sympathetic ganglia, spinal anesthesia, foreign protein febrile reactions, and re-

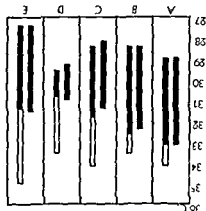


Fig. 2 Comparison of the vasodilation produced by the histamine skin test

Fig. 2 Comparison of the vasodilation produced by the histamine skin test

Rise in skin temperature produced by the vasodilation test

Rise in skin temperature produced by the histamine skin test

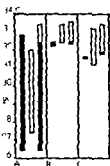
A, Angina pectoris left stellate and second and third thoracic sympathetic ganglia anesthetized with 1 per cent procaine. Histamine skin test performed in 15 min. B, Spinal anesthesia W S C, Histamine skin test performed in 15 min. C, Foreign protein febrile reaction M C, Chronic prostatitis, 25 million killed typhoid bacteria introduced intravenously. D, Reflex vasodilation of one extremity by warming another. E, Normal lower extremities immersed in water at 45 degrees C. Histamine skin test performed in upper extremity in 30 minutes. F, Acute infection with fever M C, Acute pharyngitis, mouth temperature 39.6 degrees C. Histamine skin test performed in upper extremity.

flex vasodilation of one extremity by heating another. In addition the histamine flare test was carried out in an individual who had a fever due to pharyngitis. The results are shown in Figure 2. The results were similar in each instance to those obtained in the aforementioned peripheral nerve anesthesia experiments. Complete peripheral vasodilation was not obtained by any of the methods used. Each of the various procedures caused a rise in the skin temperature with some flushing of the skin, but local stimulation of the same skin area by histamine produced an intense red flare and a further rise in the skin temperature. These experiments support our hypothesis that there are two types of peripheral vasodilability, one type controlled by central sympathetic stimuli and another controlled by a local mechanism.

A similar study was made with patients suffering from peripheral circulatory disturbances in order to determine the type of vasodilator present in each. For this purpose 2 cases of senile arteriosclerosis, 2 cases of Raynaud's disease, and 1 case of acrocyanosis were studied. In each individual the peripheral nerve anesthesia method of producing arterial dilation was used. The histamine skin test was performed after complete anesthesia was obtained in the area tested, and also in control unanesthetized areas. The results are shown in Figure 1.

In the patients with arteriosclerosis there was only a slight rise in the skin temperature following both the nerve anesthesia (27.2 degrees C, 28.0 degrees C) and the production of a flare in the unanesthetized skin (27.2 degrees C, 29.0 degrees C). The high temperature of a flare in an anesthetized area was 1.4 degrees C above that of the surrounding skin. All the temperatures taken were far below the normal averages indicating marked circulatory impairment. Very little vasodilation was produced by either the blocking of the central vasomotor stimuli or by the local stimulation of the skin with histamine. The circulatory impairment was obviously due to organic vascular changes. The 2 cases of early thrombo-angitis obliterans each had a moderate rise in the skin

In both patients with Raynaud's disease examined there was a marked rise in the temperature of the skin following nerve anesthesia. The original temperatures of the unanesthetized skin in these cases were very low and there were signs of organic vascular changes such as absence of pulsation in the various arteries. However, the rise obtained in the skin temperatures which reached the normal average in several instances, was evidence of concomitant arterial and arteriolar spasticity and the presence of adequate collateral channels.



■ Rise in skin temperature produced by peripheral nerve anesthesia  
 □ Rise in skin temperature produced by histamine skin test  
 ▨ Rise in skin temperature produced by the combined tests

Fig. 3. Comparison of the vasodilatation produced by the peripheral nerve anesthetization test and the histamine skin test before and after sympathetic ganglionectomy. D.S. Vasomotor disturbance of lower extremities with marked arterial and moderate arteriolar spasticity. A. Before lumbar sympathetic ganglionectomy. B. One day after lumbar sympathetic ganglionectomy. C. Six months after lumbar sympathetic ganglionectomy.

thetization (33.2 degrees C, 33.8 degrees C) and a comparatively moderate rise in the temperature in the flares produced in the unanesthetized skin (31.2 degrees C, 31.6 degrees C). The highest temperature of a flare in an anesthetized area was 1.4 degrees C above that of the surrounding skin which was already elevated above normal. The skin temperatures obtained following nerve anesthetization were slightly higher than those obtained in the normal individuals even though the starting temperatures were much below normal. Our results indicated that in each of the cases there was both arterial and arteriolar spasticity. The greater temperature rise in the skin following nerve anesthetization than that produced by histamine flares in the unanesthetized skin, however, suggested that the spasticity of the terminal arteries, which was relieved by removal of the central vasomotor impulses, was more marked than the spasticity of the arterioles and capillaries, which was relieved by local stimulation with histamine.

In the case of acrocyanosis there was only a slight rise in the skin temperature following anesthetization (29.6 degrees C) but there was a very marked and rapid rise in the tem-

peratures of the histamine flares in the unanesthetized skin (32.6 degrees C). The temperature of the flare in the anesthetized area rose 3.8 degrees C higher than that of the surrounding skin. There was greater vasodilatation produced by local stimulation with histamine than by removal of the central vasomotor impulses.

We then examined an individual who was subjected to a bilateral lumbar sympathetic ganglionectomy for a vasomotor disturbance of the lower extremities without demonstrable organic changes in the blood vessels. This patient was studied by means of the peripheral nerve anesthetization and the histamine skin tests before operation, one day after sympathetic ganglionectomy, and 6 months after sympathetic ganglionectomy. The results are shown in Figure 3. The sympathetic ganglionectomy produced, on the following day, a rise in the skin temperature which was equal to that of the previous nerve anesthetization. Anesthetization of the peripheral nerve produced a marked rise in the skin temperature before the operation but failed to do so both 1 day and 6 months after the sympathetic ganglionectomy. The temperature of the toes remained elevated 6 months after the operation but to a somewhat lesser degree than immediately after operation.

Prior to the sympathetic ganglionectomy, the histamine skin test caused a moderate temperature rise in the unanesthetized skin of the lower extremities, and when performed in an anesthetized area of skin in which the temperature was already elevated, it caused a still further rise. Following the operation the temperature of a histamine flare in the sympathetomized area was greater than that of the surrounding skin, and on both the first day following the operation and 6 months later the height of the temperature attained in the flare was as great as that in the flare in an anesthetized area before the sympathectomy.

Following the actual removal of the sympathetic pathways to the lower extremity, anesthetization of the peripheral nerves failed to produce further vasodilatation or to elevate the skin temperature, but stimulation of the skin locally with histamine did produce such a rise in the skin temperature, apparently by

Our experiments bring together the various theories of peripheral Vasospasms and offer an explanation for the conflicting statements in the literature regarding the efficiency of sympathectomy in peripheral circulation. Herefore, the decision for performing a sympathectomy or ganglionectomy was made upon results obtained by the various methods of producing arterial dilatation. We have demonstrated that with none of the commonly used methods can one determine the degree of total vasospasticity in an extremity. We believe that the degree of arteriole spasticity present will determine to a great extent the end-results following sympathetic ganglionectomy. It is possible that in some of the reported failures to relieve the symptoms of vasospasticity by a sympathectomy or ganglionectomy a high grade of arteriole spasticity was present. We believe that the combination of the histamine flare test and peripheral nerve anasthetization offers a means of determining the degree of both arterial and arteriole spasms.

To determine the type and the degree of vasospasticity in the upper extremity we carry out the following procedure. The hand is exposed on a table at about heart level in a room at 20 to 22 degrees C atmospheric temperature. The skin temperature of the dorsum of the fifth finger is then taken every 5 minutes until it remains at a constant level. A small amount of histamine solution (1:2000 histamine in 1/2 per cent procaine) sufficient to make a wheel of about 2 millimeters in diameter is injected intradermally on the dorsum of the finger and the temperature of the resulting flare recorded every 5 minutes until it has reached its height (15 to 20 minutes). The ulnar nerve is then anesthetized at the elbow, behind the medial epicondyle of the humerus, with 15 cubic centimeters of 1 per cent procaine solution. We continue to record the temperatures of the histamine flare and of another area on the dorsum of the finger outside of the flare area every 5 minutes until the height of the temperature rise produced by the nerve block is reached. This occurs usually in 15 to 30 minutes and will be evidenced by cessation of the rise in temperature in the skin areas outside the histamine flare.

These experiments bear out our contention that there are two types of peripheral Vasospasms, that of the large terminal arteries which are controlled by the autonomic nervous system and that of the arterioles and capillaries which are controlled by a local mechanism.

# EVOLUTION

The sympathetic innervation of the blood vessels of the extremities consists of postganglionic sympathetic fibers originating in the thoracolumbar ganglia which join the peripheral nerves by way of the gray rami communicantes and are then distributed to the blood vessels segmentally (8). The final distribution of these fibers to the large and small arteries has been demonstrated by numerous investigators (3), but the innervation of the terminal arterioles and capillaries has never been definitely established. No positive proof of the control of the latter by the central or the autonomic nervous systems has been given. The inability to produce complete peripheral vasodilatation by any of the known vasodilating methods or by complete removal of the sympathetic fibers leading to an extremity suggests that the autonomic nervous system does not completely control the dilatability of the peripheral arterial system. The rise in the skin temperature with only slight redness following removal of the sympathetic nerves is evidence that there is dilatation of the larger terminal arteries which must necessarily be controlled by the autonomic nervous system. The further rise in the temperature of these skin areas associated with marked redness, which is produced by a local irritant such as histamine, suggests that the dilatation of the skin arterioles and capillaries is not brought about completely, if at all, by removal of the central vasomotor impulses. This fact plus the demonstration by Smithwick, Freeman and White and others, that local vasospasms can be produced in sympathetomized extremities by appropriate stimuli in the blood stream indicate that control of the arterioles and capillaries lies in some local mechanism, either nervous or chemical, which is not completely dependent, if at all, upon the autonomic nervous system.

In the lower extremity these tests are carried out on the dorsum of the first toe. Complete anesthesia is produced in the toe by an esthetizing the posterior tibial nerve behind the medial malleolus and the common peroneal nerve below the knee as it winds around the neck of the tibia.

In analyzing the results in any case the normal averages must be kept in mind. In an individual with normal circulation, in a room at 20 to 22 degrees C, the temperature on the dorsum of the fifth finger varies between 27.8 degrees C and 29.2 degrees C and on the dorsum of the first toe between 27.2 degrees C and 28.2 degrees C. The normal height of the temperature rise following nerve anesthetization varies between 33.0 and 34.2 degrees C on the dorsum of the fifth finger and between 31.0 and 31.8 degrees C on the dorsum of the first toe. The height of the temperature of the histamine flare varies between 32.8 and 34.6 degrees C on the dorsum of the fifth finger and between 31.2 and 33.0 degrees C on the dorsum of the first toe (7).

A flare temperature within the normal limits in a skin area the resting temperature of which is normal is indicative of a moderate or normal local arteriolar spasticity. If the resting skin temperature is below normal and the final temperature is equal to or above the normal marked arteriolar spasm is present. A temperature rise below the normal in the absence of arterial spasm indicates very slight arteriolar spasticity.

A rise in the skin temperature following nerve anesthetization which is within the normal limits in a skin the resting temperature of which is normal is indicative of moderate or normal arterial spasm. If the resting skin temperature is below normal and the final temperature is equal to the normal or greater, a marked arterial spasm is present. A temperature rise below the normal in the absence of local vasospasm indicates a very slight arterial spasm.

Various combinations of the two types of vasospasm can occur as is shown in Figure 1.

#### SUMMARY

1 Evidence is presented to show the presence of peripheral arterial and arteriolar spasticity.

2 Arteriolar spasticity is controlled by the autonomic nervous system and can be relieved by sympathetic ganglionectomy.

3 Arteriolar spasticity is controlled by a local nervous or chemical mechanism the exact nature of which is uncertain. It is affected only partially, if at all, by the autonomic nervous system, and it is not directly relieved by sympathetic ganglionectomy.

4 A method is suggested for differentiating between arterial and arteriolar spasticity in the selection of cases for sympathetic ganglionectomy.

I wish to thank Dr. L. N. Katz for his kind suggestions in the preparation of this report.

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## HYDATIDIFORM MOLE AND CHORIOEPITHELIOMA

## A 5 Year Study

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positive Aschheim-Zonder tests

Of 127 cases of hydatiform mole and 28 of chorioepithelioma studied in this group, only 2 of hydatiform mole and 2 of chorioepithelioma have been previously reported

## HYDATTIDIFORM MOLE

Only 17 cases of hydatidiform mole reported in this study. Of this number 44 occurred in primiparae and 26 occurred in multiparae. In 7 instances the parity was not stated. Over 80 per cent of the hydatidiform moles occurred in the first half of pregnancy. There was only one patient who had had a

*Symptoms.* Bleeding was the outstanding previous hydatidiform mole symptom, and occurred in 122 patients. Vessels were found in 18 patients; painful contractions were present in 28, and 27 had excessive nausea and vomiting.

*Diagnosis* The diagnosis was made from curettings in 53 cases, from placental exami-

The uterus was reported as enlarged for the period of amenorrhoea in 49 patients, normal in 36, and smaller than normal in 15, in 27 no information was given.

*Occurrence with fetus*

There were only 3 cases reported in which a fetus occurred with hydridiform mole. In 1 case the hydridiform mole was found during the routine pathological study of the placenta after the normal spontaneous delivery of a living infant of 6 pounds. In another case, which had been diagnosed as missed abortion, the pathological report showed an embryo 6 centimeters in length, the pathological diagnosis was early benign hydatid mole. In the third case, the mole passed 20 days after expulsion of a fetus.

*Aschheim-Zondek test*

In considering the use of the Aschheim-Zondek test in this series, one is impressed with the fact that it was employed so infrequently. In 71 cases the test had either not been done at all or was not recorded. However, it was stated in some instances that the patient had been instructed to return for further tests but had not done so. The 56 remaining cases could be divided into two groups—in one, consisting of 28 cases, the test was done during the molar pregnancy, in the other, also consisting of 28 cases, the test was done only subsequent to treatment in the group in which the Aschheim-Zondek test became negative in 11 cases after evacuation, in 8 after hysterectomy, in 2 after vaginal hysterectomy.

and in 1 after normal spontaneous delivery of a 6 pound infant (hydatid changes were found in the placenta). In 3 instances no Aschheim Zondek test was done after hysterectomy. In 1 case the test was positive on 2 occasions after curettage, further tests were not obtained. In 1 case repeated Aschheim Zondek tests remained positive for a 3 months' period after removal of a vaginal implantation, at which time the chorioepithelioma was discovered.

In the group in which Aschheim Zondek tests were done only subsequent to treatment, the test showed negative results after curettage in 14 cases, after hysterectomy in 6, after passage of the mole in 2, and after vaginal hysterotomy in 1. In 2 instances the test remained positive after curettage, further Aschheim-Zondek tests were not done. In one case a supravaginal hysterectomy was done for persistently positive Aschheim Zondek tests, but no hydatidiform mole or chorioepithelioma was demonstrable in the pathological specimen—no explanation was given for the positive reaction, and further tests apparently were not done. In another instance the test was negative the day before removal of the hydatidiform mole with sponge forceps, then positive 6 days later when a complete hysterectomy and bilateral salpingo oophorectomy was performed. The pathological diagnosis after hysterectomy was syncytioma, therefore, the result of the first Aschheim Zondek test must have been a false negative.

In 4 cases the urine was diluted to the point of obtaining a negative test in 1 to 10 cubic centimeter, in 2 to 0.1 cubic centimeter, and in 1 to 0.01 cubic centimeter.

In only 1 case which also had chorioepithelioma, was a quantitative estimation of prolan made. Seventy thousand mouse units of prolan per liter of urine were found.

In attempting to ascertain the time when the Aschheim Zondek test became negative after operation it was found that no definite conclusions could be drawn because there was such a great diversity in the number of tests done and in the number of intervening days. In some instances only one test was done long after operation. It was noted however that the majority of negative tests were reported in a period ranging from 10 to 30 days. Obvi-

ously, the only way to determine on what postoperative day the Aschheim Zondek test becomes negative is to do a daily test. But in practically all the cases herein studied this was not done. In the very few instances in which it was done, it was observed that the test became negative on the fifth or sixth postoperative day. In every instance following the removal of hydatidiform mole or operation for chorioepithelioma, the Aschheim Zondek test should be done daily until it becomes negative, then weekly for a month, and finally monthly for a few times. Only in this way can exact data be collected and can one be sure as to the presence or absence of the growth.

It might be well at this point to discuss the use of the Aschheim Zondek test in relation to hydatidiform mole and chorioepithelioma. In the first place, one must remember that an incidence of laboratory error up to 2 per cent is to be expected. We should know that with the use of immature rabbits a false negative test is more probable than a false positive test. Therefore, a negative test which does not agree with the clinical picture might be false, and another test should be made, extreme care being used in collecting and labeling the urine specimen and in the technique of the test.

There appears to be a misconception that an increase of the ordinary amount of prolan in the urine of the pregnant woman indicates decisively that hydatidiform mole or chorioepithelioma is present. This is a fallacy and should not be perpetuated. I have seen cases in which there was a strongly positive Aschheim Zondek reaction with only 1 drop of urine when there was a normal pregnancy, and I have seen a case of chorioepithelioma in which the test was negative with 1 cubic centimeter of urine. There are reports in the literature in which 50,000, 80,000, and even 200,000 units of prolan per liter have been found in the urine of a normally pregnant woman.

May I suggest that in cases in which the question of hydatidiform mole and chorioepithelioma is involved, we be absolutely meticulous in our use and technique of the Aschheim Zondek test. Our greatest pitfall



nancy. She had hypertension with visual disturbance, epigastric pain, and albuminuria. No vesicles were seen. There was no bleeding or other evidence which might have aided in the diagnosis. Because of the severe fulminating toxemia, a therapeutic abortion was done at 2½ months and a hydatidiform mole was removed, following which the patient died in 24 hours. There were no Aschheim-Zondek tests made and no autopsy recorded. All other information was lacking.

Case 2 Mrs E S, aged 46 years, had had 3 full term spontaneous deliveries with no previous history of hydatidiform mole. There was considerable bleeding when the patient was first seen, but the diagnosis was not made until the mole was passed in the third month. Twenty-two days later a hysterectomy was performed. The type of hysterectomy was not stated, and no reason was given for it. The patient died of streptococcal peritonitis 5 days after the hysterectomy. There were no Aschheim-Zondek tests done and no autopsy reported. It was stated that the ovaries were not enlarged on palpation, that lutein cysts were not seen at operation, and that chorioepithelioma was not found in the specimen.

Case 3 Mrs E F, aged 48 years, with 3 living babies and 8 miscarriages, had intermittent bleeding from the uterus. When seen, she was supposed to have been in the sixth month of pregnancy. A tumor was found extending to the umbilicus. No fetal movement was apparent and no fetal heart sounds were heard. Before operation a diagnosis of placenta praevia was made. Allow amputation of the uterus was done. The uterus after removal was found to be filled with a hydatidiform mole. The patient died on the operating table.

In Findley's collection of 500 cases, reported from the literature in 1910, chorioepithelioma occurred in 157 cases, or 31.4 per cent of the reported hydatidiform moles. In our series this incidence was only 9.4 per cent. The difference is explainable by the fact that Findley's cases were almost all reported from the literature while ours were collected from records after being sought for. It is obvious that the incidence of chorioepithelioma would be much higher in a group of reported cases than in a group of unreported cases.

In Findley's series, 11 of 87 patients with benign hydatidiform moles died (12 per cent), and 46 of 99 patients with malignant moles died (46 per cent). In our series nearly every patient was operated upon, while in Findley's series 43.2 per cent of the patients delivered the hydatidiform mole spontaneously. This fact, plus the type of operation done, certainly accounts for a great deal of the difference.

is the false negative. I cannot believe that at any time in the transition of hydatidiform mole to chorioepithelioma there is any period in which the test is negative. I cannot believe that in the presence of chorioepithelioma it is possible to find an Aschheim-Zondek test fluctuating from negative to positive. For this reason, it would appear that if following hydatidiform mole one gets two or three negative tests (enough to avoid the possibility of a false negative) he can be sure no chorioepithelioma will develop from that molar pregnancy. I feel that we can rightfully conclude that as long as there is living chorionic tissue present the Aschheim-Zondek test will be positive, and if there is no living chorionic tissue present the Aschheim-Zondek test will be negative.

**Operation.** Dilatation and curettage was done on 94 patients, and hysterectomy on 29. Thirteen of the hysterectomies were supravaginal, 6 were total, and 10 were not designated as to type. Uterine packing and vaginal hysterectomy were each performed twice. The hydatidiform mole passed spontaneously 46 times.

**Condition of the ovaries.** The condition of the ovaries was apparently noted in only 28 cases, in 12 there was palpable enlargement, and in 14 there were lutein cysts. In the group with palpably enlarged ovaries, laparotomy was done on 9 patients, 5 of these had lutein cysts, and 2 had cysts which were not stated to be lutein. In those who died in this series, no enlargement of the ovaries and no lutein cysts were found.

**Subsequent pregnancies.** Subsequent pregnancies were reported in 16 patients, and in 1 of these, at the second pregnancy, there existed simultaneously an hydatidiform mole and a chorioepithelioma. In this series, 12 patients (9.4 per cent).

**Deaths.** There were 3 deaths reported in the whole series of 127 hydatidiform moles, a percentage of 2.36. The detailed account of the deaths follows.

Case 1 Mrs M W had had 3 normal pregnancies and deliveries and gave no history of previous hydatidiform mole. She entered the hospital with severe toxemia in the second month of preg-

ence in the mortality—modern conduct, better diagnosis, and earlier treatment were important factors in the lowered mortality, such *passé* methods as the use of the bougie, hydrostatic bag, and digital removal were not practiced. In our series the use of the Aschheim Zondek test certainly saved some lives.

It would appear that immediate hysterectomy, once the diagnosis is established, would be the surest method of prophylaxis against chorioepithelioma, but this is rather formidable treatment. As can be seen by our study of this series the operation would have been done needlessly 115 times, for only 12 patients developed chorioepithelioma after hydatidiform mole. What is more, hysterectomy would have prevented no deaths in our series, since 1 patient died of fulminating toxemia before the diagnosis was made and 2 deaths actually followed hysterectomy. In studying this series one wonders if hysterectomy would have saved any of the patients who died subsequently of chorioepithelioma. In the detailed account of the 2 deaths which occurred from chorioepithelioma we find that in the first case hysterectomy was done as an emergency when the first symptoms appeared and when there was no evidence of hydatidiform mole, and that this death took place on the operating table. In the second death from chorioepithelioma, the malignant growth actually occurred with the pregnancy and there was no history whatever of hydatidiform mole. We can draw the conclusion from our study of the present series, that hysterectomy *per se* as treatment for hydatidiform mole would not have saved any lives.

I believe that hysterectomy should be done as soon as the diagnosis is made only on patients near the menopause or when the mother already possesses sufficient children and I disagree with Caturani who states that all forms of chorionic tumors should be treated according to the general criteria adopted for malignant tumors. I do believe, however, that all forms of chorionic tumors should be watched and studied as potentially malignant tumors. In other patients, one should do a careful but thorough curettage followed by packing in case of hemorrhage, to clean the uterus and to aid in arriving at a diagnosis.

And because a curettage does not of necessity remove chorionic tissue buried in the myometrium or a sinus, frequent Aschheim Zondek tests should be done for the purpose of establishing the fact as to whether or not there is living chorionic tissue still remaining. Hysterectomy should be resorted to if there is a persistently positive Aschheim Zondek test, and if one is sure that the uterus has been properly emptied and that no intervening pregnancy has taken place. This method appears at this time to offer the maximum percentage of prevention and cure and the minimum amount of unnecessary operations.

Further, by way of prophylaxis against serious complications and chorioepithelioma, the alert practitioner should be suspicious of the pregnant woman who has a uterus enlarged out of proportion to the age of her pregnancy, who has excessive nausea and vomiting, who bleeds and has painful uterine contractions, and who aborts. In such patients he should watch for vesicles, have the abortion tissue examined, and use the Aschheim Zondek test after doubtful or suspicious abortions. And, too, the woman who bleeds from an unknown cause after abortion or delivery should be watched with the idea of chorioepithelioma in mind and the Aschheim Zondek test should be used as a check.

#### CHORIOEPITHELIOMA

**Parity.** In this study 38 cases of chorioepithelioma are reported. Nineteen occurred in multipara and 9 in primipara. Fifteen chorioepitheliomas of this series followed moles, 7 followed pregnancies or abortions, 5 existed simultaneously with mole, and 1 occurred coincidentally with pregnancy.

**Symptoms.** As was the case with the moles, bleeding, nausea and vomiting, and painful uterine contractions were the outstanding symptoms. Twenty-five patients bled, 3 had nausea and vomiting, 5 had pain, and 1 had absolutely no symptoms.

**Diagnosis.** The diagnosis was made clinically and with the aid of the Aschheim Zondek test in 9 cases, from curettages in 13, after hysterectomy in 4.

**Aschheim Zondek test.** In the chorioepithelioma series, the Aschheim Zondek test

deaths (71 per cent). A detailed account of

Case 1. Mrs. E. F., aged 48 years, primipara (all living), who had a history of a number of abortions, missed her menstrual periods for 3 months, then began to flow at frequent intervals. An emergency supravaginal hysterectomy was done because of the profuse hemorrhage. The patient died on the operating table. The type of chorioepithelioma was not stated. No history of previous mole was mentioned, and there was no autopsy. No other information was given.

Case 2. Mrs. S., aged 29 years, quadrapara, entered the hospital with severe vaginal bleeding. Blood pressure was 70/26. She gave no history of hydatidiform mole, but stated that she had not menstruated for 36 days. Curettage was performed, and the presence of both types of chorionic villi epithelium complicated the final pathological description even though the syncytial cells predominated. The next day the Aschheim-Zondek test was positive. On the following day a panhysterectomy and bilateral salpingo-oophorectomy was done and a round, purplish gray growth, 1.5 centimeters in diameter, was found near the fundus, projecting into the endometrial cavity. No metastases were found at the time of this operation, and no lutein cysts were seen in the ovaries. The pathological report was as follows: "Both ovaries normal. Chorioepithelioma of the uterus, of the choriochorionoma type." Ten days later examination revealed the presence of a typical dark purplish nodule, 0.5 centimeter in diameter, on the anterior vaginal wall. The Aschheim-Zondek tests were all positive, several having been made. One test with 5 cubic centimeters of the spinal fluid was positive. The urine was not positive in high dilution, but was constantly positive with 1 cubic centimeter of urine. Both x-ray and radium were used on the growth in the anterior vaginal wall. The patient died 110 days after the first symptoms. There were no metastases of the lungs visible by x-ray.

Every case of chorioepithelioma in which an Aschheim-Zondek test was reported gave a positive test. Every case of hydatidiform mole in which an Aschheim-Zondek test was reported gave a negative test. It is impossible to conceive of a negative Aschheim-Zondek test in the presence of chorioepithelioma. However, one can conceive of a negative Aschheim-Zondek test in a case of hydatidiform mole. It is logical to assume that the case in which the Aschheim-Zondek test was negative the day before the hydatidiform mole was removed by sponge forceps comes in a class analogous to missed abortion and could be called missed molar abortion. In such a case, the hydatidiform

was used in 50 per cent of the 28 cases. In 12 the test was done both before and after hysterectomy, and in each instance it became negative after the operation, but in 1 it became positive. This patient died in 2 cases the test was done only after hysterectomy, and in both was reported negative.

Profan was estimated in 2 cases. In 1 (where chorioepithelioma occurred simultaneously with hydatidiform mole), 70,000 mouse units of profan per liter of urine were found, and after hysterectomy the Aschheim-Zondek test was negative. In the other, 4,000 rat units of profan per liter of urine were found 4 days after curettage. Another profan estimation in this case 5 days after panhysterectomy and salpingo-oophorectomy, performed approximately 5 weeks after the curettage, showed 50,000 rat units of profan per liter of urine, subsequent Aschheim-Zondek tests were negative.

*Operation.* In treating these patients, 24 hysterectomies were done, 14 total and 10 supravaginal. Three patients were treated by dilatation and curettage. One had a vaginal implantation removed.

*Condition of the ovaries.* Of the 28 cases of chorioepithelioma, lutein cysts were reported in 7, in 9 there were no cysts, and in 12 the condition of the ovaries was not reported. Both ovaries were removed in 12 patients, 7 of whom were under 30 years of age.

*Classification.* The pathological report as to type in the chorioepithelioma series was as follows: syncytoma in 8 cases, chorioadenoma, in 1 of choriochorionoma, and in 1 in the cases of syncytoma, in 2 of chorioadenoma, in 12. Lutein cysts were found in 4 of 5, choriochorionoma in 3, and not stated in 1. In each instance this treatment followed operation. The patient who had the combined radium and x-ray treatment died.

*Deaths.* While Findley's study of 99 cases of chorioepithelioma showed 46 deaths (46 per cent) our study of 28 cases showed only 2

form mole would be entirely separated from its uterine attachment—still lying in the uterus, but absolutely separated from all circulation. This compares in a manner to missed abortion where the placenta and fetus are still lying in the uterus absolutely unattached and where there would be a negative Aschheim Zondek test.

I have endeavored to correlate our findings regarding enlarged ovaries or lutein cysts in relation to hydatidiform mole and chorioepithelioma, but at this time I am unable to make any progress in this correlation. I have attempted to correlate the occurrence of lutein cysts with the stage of development of the growth, and to correlate the occurrence of lutein cysts with the pathological type of the growth, with metastasis, or with fatality, but I can see no correlation whatever. However, in the 7 cases in the chorioepithelioma series in which lutein cysts were reported as being present, with the exception of the one patient seen late and who died of lung metastases, the diagnoses were made comparatively early. I hope that in future cases special attention will be paid to the ovaries examined on palpation and those seen at laparotomy.

In the past decade, many previously unknown facts have been brought to bear on the study of hydatidiform mole and chorioepithelioma. The use of the Aschheim Zondek test in both diseases, the proper pathological classification of chorioepithelioma, and the type of operation best suited to cure the condition, are all comparatively recent advances. In hydatidiform mole after passage or re-

moval of the mole, the judicious use of the Aschheim Zondek test has enabled us to determine whether or not any portion of the mole remains or whether there has been a transition to chorioepithelioma.

Practically 80 per cent of the chorioepitheliomas were found within 20 days after the passage of the mole in those cases in which the patient had been properly examined, in which sufficient Aschheim Zondek tests had been done, and in which pathological specimens were examined. This fact, plus my own clinical experience, has led me to the hypothesis that certain cases of mole have the potentiality of malignancy. In these patients the malignancy is present with the mole—the actual malignant chorionic changes have already taken place, and even though the mole be removed, the malignant cells are left. At this time the Aschheim Zondek test will be positive and will remain positive until the chorionic tissue is dead or has been removed. By the use of the pathological examination and classification of the growth, and by the results of the Aschheim Zondek tests in cases of chorioepithelioma, we can treat patients in most cases early enough to avoid metastases and to save the woman and her ovaries.

NOTE.—The author is indebted to practically every member of the Pacific Coast Society of Obstetrics and Gynecology for the case histories.

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# FALLACIES CONCERNING CHEMICALLY STERILIZED SURGICAL CATGUT SUTURES

With Particular Reference to the Use of Metallic Silver

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THE problem of sterilizing surgical catgut sutures by some chemical method has received intensive study for many years by investigators in several countries. In fact, the chemical compounds which have been used in an attempt to destroy bacteria commonly present in raw catgut are almost legion. During the course of his investigations, Alajale tried out many compounds, including silver nitrate, but found them lacking in true bactericidal properties so far as catgut was concerned. Bulloch reviewed the disinfecting power of numerous chemicals, among which were silver compounds, and found them inefficient as sterilizing agents for commercial catgut.

*Silver catgut.* And now there has appeared on the market silver catgut which is a new representative of the chemical method of sterilizing catgut sutures. As reported by Lieb, the method of saturating surgical dressings and sutures with metallic silver was devised by Kopetschni, and the final product is supposed to possess "optimal oligodynamic action." Lieb states:

"This type of silver impregnation is able to destroy or render harmless all the germs and their spores located in the raw catgut, and in addition any stray germs of the silver catgut. Moreover, the silver has an absolutely non irritant and even a heterogeneous action on the living tissue.

"The idea of saturating catgut with silver as a chemical sterilizing agent closely parallels that of attempting to sterilize catgut sutures with some of the other heavy metals, notably copper and mercury. Therefore, a concise presentation here of the results of my earlier research studies, in which the sterility of copolymerized and mercaptanized catgut sutures was investigated, may serve to clarify the study of chemical sterilization as it is applied to silver catgut which forms the basis of the present paper.

In a previous paper (4), I described the results of my research on the possibility of effectively sterilizing catgut by means of chemical treatment. The sterilizing action of 27 different chemical compounds, including various salts of two of the heavy metals (copper and mercury), was found to be inefficient and unreliable when applied to several thousand catgut sutures. Accordingly, I endeavored to

Lieb used what he termed "a special test" for studying the bactericidal action of the silver saturation process on artificially infected catgut. He smeared a culture containing spores of *Bacillus anthracis* on two pieces of water-soaked catgut about 2 centimeters long. One was placed on an agar plate, the other was saturated with silver and then placed on an agar plate. Both plates were incubated at 37 degrees C for 48 hours. The non-saturated catgut presented a zone of bacteria, while the

Very probably the silver surface fixed to the surgical dressing gives off silver ions, yet in such small quantities that the concentration of the dissolved ions can not yet have any injurious irritant effect, although it is quite sufficient to develop any bactericidal properties.

emphasize the fact that "*the net results indicate the fallacy of the chemical method of sterilizing catgut*"

**Copperized catgut** This was first prepared by von Linden at the University of Bonn in Germany. It was claimed that by saturating catgut with copper salts, such treatment would completely sterilize the sutures, destroying even tetanus spores, and that such sutures would remain sterile for weeks, even when left exposed to air and dust.

In my paper on chemical sterilization (4), I pointed out the fact that copper salts had been demonstrated to exert a bacteriostatic action on bacteria, thereby depriving them of nutritional support and preventing their multiplication, but that the bacteria may be reactivated by means of a neutralizing solution capable of redissolving the copper salts. My bacteriological tests, in which I used an effective neutralizing fluid for removing all the copper from the catgut as a preliminary step, when applied to 36 copperized catgut sutures of a German manufacturer and 156 copperized catgut sutures of three American manufacturers, showed that 19 of the German and 42 of the American sutures contained living bacteria. When copperized catgut sutures were embedded in the tissues of laboratory animals, the results showed that these sutures were less readily absorbed and were definitely *more irritating* than plain catgut untreated with copper.

**Mercurialized catgut** In 1932 chemical analyses of catgut sutures of an American manufacturer showed them to be heavily impregnated with a mercury compound, and, when such sutures were tested bacteriologically by the Meleney and Chatfield method, entire absence of bacterial growth was indicated. Further investigation revealed that the neutralizing fluid (1 per cent sodium thiosulphate and 1 per cent sodium carbonate) recommended by these authors would not remove all the mercury compound from the sutures. Subsequently, the sutures of a British manufacturer were likewise found to contain such a large amount of the soluble mercury compound that the neutralizing solution (1 per cent sodium thiosulphate and 1 per cent sodium carbonate), specified in the Therapeutic Substances (Catgut) Regulations of

1930, would not remove all the mercury compound from the catgut.

Further research studies demonstrated that all the mercury compound could be removed by means of a special neutralizing solution of 10 per cent sodium thiosulphate. When this solution was used as an additional preliminary step in the bacteriological technique, subsequent lots of sutures from the American and from the British manufacturer showed an abundance of bacterial growths in the aerobic and in the anaerobic tubes. This special neutralizing solution is now embodied as part of my technique (5), in which it is described as Formula B. Thus, just as my research work proved copperized catgut to be a fallacy so far as sterility is concerned, so also has it demonstrated with equal forcefulness the fallacy of attempting to sterilize catgut sutures with mercury compounds.

#### SILVER CATGUT SUTURES

The broad claims advanced by Linhart concerning the absolute sterility of silver catgut seemed to indicate that an effective method of chemical sterilization of surgical catgut had been developed. Naturally, this evoked my interest and for two reasons: first, because Mackie as well as Bulloch had investigated the value of silver compounds as sterilizing agents for catgut and found them inefficient, and second, the intensive study (4) which I had made during a period of 2½ years of the possibility of effectively sterilizing catgut by means of chemical treatment, involving 27 different compounds, proved conclusively the fallacy of chemical sterilization of surgical catgut. Therefore, it seemed desirable to subject silver catgut to a comprehensive series of tests with the object of corroborating, if possible, the findings on which Linhart based his claims. I decided to undertake such an investigation and, in the latter part of 1935, I purchased in the open market a quantity of silver catgut consisting of several sizes of sutures (Nos. 0, 1, 2, 3, and 4).

#### EXPERIMENTS AND RESULTS

**Bacteriological tests** Several sutures of the silver catgut, comprising sizes 0, 1, 2, 3, and 4, were tested for sterility in accordance with the

TABLE I—SILVER CATGUT SUTURES.

Series No	Size	Aerobic tests						Anaerobic tests			
		Tube x	Tube z	Tube 3	Tube 4	Tube 5	Tube 6	Tube 7	Tube 9		
B31	0	0	0	0	0	0	0	0	0		
B32	1	0	0	0	0	0	0	0	0		
B33	2	0	0	0	0	0	0	0	0		
B34	3	0	0	0	0	0	0	0	0		
B35	4	0	0	0	0	0	0	0	0		
B36	0	0	0	0	0	0	0	0	0		
B37	0	0	0	0	0	0	0	0	0		
B38	1	0	0	0	0	0	0	0	0		
B39	1	0	0	0	0	0	0	0	0		
B40	2	0	0	0	0	0	0	0	0		
B41	2	0	0	0	0	0	0	0	0		
B42	3	0	0	0	0	0	0	0	0		

Exploration of bacteriological and histological reactions in the tubercle at end of 15 days incubation. Chemical analysis showed that this culture contained over 2% per cent metallic silver, also that the silver was not removed from the surface by a 5 hour immersion in 5 per cent sodium thiosulphate used as a neutralizing solution in this technique.

when incubated in the solution for 24 hours. Further research demonstrated that this could be attained by means of a neutralizing fluid consisting of 10 per cent sodium thiosulfate in which the calgut must be incubated for not less than 48 hours. This is the special neutralizing fluid described as Formula B in my bacteriological method (5) and which I had found to be so efficient, as an additional preliminary step to my regular technique, for removing large amounts of mercury and iodine from calgut.

[illegible]

technique used by the Bacteriological-Serological Research Institute in the Federal Ministry for Social Administration (Public Health Office), Vienna, as described in reports submitted by the manufacturer. Under aseptic technique, the sutures were placed in test tubes containing a sterile solution of 5 per cent sodium thiosulphate for 2 hours, and then they were immediately transferred to test tubes containing a sterile culture medium previously described (5). One-half the quantity of each of the different sizes of sutures was cultured aerobically and the other half anaerobically. At the end of the 15 day incubation period, there was entire absence of bacterial growth in all tubes (Table I). These results seemed to corroborate the claims of Linhart and those of the manufacturer that silver catgut sutures are sterile.

*Chemical analyses* Next, the various sizes of silver catgut were subjected to chemical analyses which revealed a large amount (over 2 per cent) of metallic silver in the sutures. Investigations were then conducted for the purpose of devising a suitable neutralizing fluid effectively to remove all the silver from the sutures. It was found that a solution of 5 per cent sodium thiosulfate would not remove all the silver when the catgut was left in this neutralizing fluid for 2 hours, nor even

progress, 20 day chromic catgut sutures (sizes 0, 1, and 2) of a standard brand which were sterilized by heat, and similar sizes of the silver catgut sutures, were embedded in living animal tissues for the purpose of determining the relative degree of tissue irritation, if any, and the comparative rate of absorption of the two varieties of catgut.

Each of these two kinds of sutures was embedded in the submucosal layer of the cat's stomach. The animals were sacrificed at intervals of 3, 5, 8, 12, 20, and 30 days. After noting the gross pathological appearance of the removed stomachs, illustrative pieces of tissue containing the sutures were placed in 10 per cent formaldehyde and histological sections made and mounted on microscopic slides. Simple hematoxylin eosin stain as well as the fibrous tissue differential stain of van Gieson was used.

A study of the histological appearance of the tissues after the sutures had been embedded for 3 days showed almost complete absorption of sizes 0 and 1 of the silver catgut sutures, together with a *ery marked leucocytic reaction with infiltration of cells of abscess like appearance*. The size 2 silver catgut sutures showed partial absorption together with a very marked polymorphonuclear leucocytic reaction. The histological appearance of these silver catgut sutures showed that their tensile strength at this time must have been negligible. The 20 day chromic catgut sutures used as a control showed entire absence of absorption and almost no tissue reaction.

Examination of the tissues after the sutures had been embedded for 5 days showed that *all sizes of the silver catgut sutures had been completely absorbed except for a few fragments* and there was a *ery extensive leucocytic reaction* extending through the surrounding tissue. On the other hand the 20 day chromic catgut sutures were well preserved and accompanied by relatively little tissue reaction.

The silver catgut sutures that were embedded in the tissues for 8 days were completely absorbed and there was a moderate cellular reaction at their former site in the submucosa while the 20 day chromic catgut sutures were well preserved with slight tissue reaction surrounding them.

Examination of sections of tissues in which the two series of sutures had been embedded for 12, 20, and 30 days revealed no evidence of the silver catgut sutures. On the other hand, the control sutures of 20 day chromic catgut which had been embedded for periods of 12 and 20 days were well preserved and showed moderate fibroblastic reaction, while the control sutures that were embedded for 30 days could still be identified by a few remaining fragments in the submucosa, and adjoining this zone was a small circumscribed region of fibroblasts.

#### DISCUSSION OF RESULTS

**1 Bacteria** The results of my bacteriological tests of silver catgut sutures, wherein living spore forming bacteria were found, appear to refute completely Linhart's statement that the process of silver impregnation used in the preparation of silver catgut "is able to destroy or render harmless all the germs and their spores located in the raw catgut." The presence of these living, spore bearing microorganisms, which I demonstrated in the silver catgut sutures, also disproves the claim that silver catgut sutures are absolutely sterile when manufactured.

**2 Neutralizing fluids** The results of my researches on silver catgut have again emphasized the fact that falsely negative findings may follow bacteriological tests applied to sutures unless a close check up is always made first, by subjecting some of the sutures to careful chemical analyses to determine the nature and quantity of the chemical compound that may be present, second, by using, in connection with the bacteriological tests, a suitable neutralizing fluid which will dissolve and *completely remove* the chemical compound found to be present.

My experiments have also proved the fallacy of using 5 per cent sodium thiosulphate for 2 hours as a neutralizing solution, and then immediately transferring the silver catgut to nutrient culture medium. This is the technique used by the Bacteriological Serological Research Institute in the Federal Ministry for Social Administration (Public Health Office), Vienna. There are two good reasons why this technique fails to detect the living bacteria in



TABLE II—SILVER CATGUT SUTURES\*

Series No	Size	Aerobic tests										Anaerobic tests									
		Tube 1	Tube 2	Tube 3	Tube 4	Tube 5	Tube 6	Tube 7	Tube 8	Tube 9	Tube 10	Tube 11	Tube 12	Tube 13	Tube 14	Tube 15	Tube 16	Tube 17	Tube 18	Tube 19	Tube 20
831	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
832	1	45 hrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
833	2	48 hrs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
834	3	48 hrs	6 days	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
835	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
836	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
837	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
838	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
839	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
840	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
841	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
842	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
843	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

\*Tested by standard Clock method but a special neutralizing solution of 10 per cent sodium thiosulphate was used as a preliminary additional step. Exploratory. <sup>12</sup>Indicates bacterial growth, followed by the number of hours or days incubation that elapsed before growth appeared. 0 means entire absence of growth in the tube at end of 15 days incubation. These sutures, were taken from the same lots and bore the same date numbers as the sutures used for the tests shown in Table I. Before being put through the standard Clock technique these sutures were transferred aseptically to tubes of sterile 10 per cent sodium thiosulphate and incubated for 48 hours to remove the large amount of silver (over 2.5 per cent).

the silver catgut. First, the large amount of silver in the catgut cannot be removed in 2 hours nor in 24 hours by this neutralizing fluid. As is pointed out below, silver has a bacteriostatic action, and the large amount of the metal remaining in the sutures after they have been in contact with 5 per cent sodium thiosulphate for 2 hours prevents bacterial growth. Second, no provision is made in this technique for removing from the sutures the soluble double salt of silver and sodium thiosulphate ( $\text{NaO}_2\text{S}_2\text{Ag} \cdot 2\text{Na}_2\text{SO}_4$ ), and with which the sutures are saturated as a result of their immersion in the neutralizing solution, before placing the sutures in the culture medium, and, hence, this double salt is carried over into the culture medium where it tends to inhibit bacterial growth. Therefore, this technique permits two chemical compounds to act as inhibiting agents of bacterial growth: first, dissolved out by the neutralizing fluid, and, second, the soluble double salt present in the sutures after their stay in the neutralizing so-

lution and which is carried over by the sutures into the culture medium. It is to be noted here that Buehman recommended rinsing after the silver had been neutralized with sodium thiosulphate, and in the improved technique which I devised (4) and recommended (5) for testing the sterility of catgut sutures which are heavily impregnated with metals, the sutures are transferred to distilled water after the preliminary treatment in the special neutralizing fluid.

3. Bacteriostatic action of silver. From a study of the results of my researches on silver that when catgut sutures are treated with metallic silver, an arrested development of the bacteria within the catgut is brought about through the bacteriostatic action of silver. It seems apparent that the silver acts on the bacterial colloid in such a manner that even in the presence of a suitable culture medium the bacteria are deprived of their nutritional support. This action is analogous to that of copper and mercury (4). It is equally evident

from my experiments that the removal of all the silver from the catgut by means of an effective neutralizing fluid of 10 per cent sodium thiosulphate for not less than 48 hours reactivates the bacteria, so that when nutritional support is provided in the form of a proper culture medium bacterial growth occurs. My experiments herein described have demonstrated conclusively that *metallic silver does not effectively sterilize catgut*.

Kruse and Fischer claimed to have activated metallic silver by direct action of an electric current, producing silver chloride with reputed oligodynamic action. However, they frankly admit that by their silver treatment bacterial spores are not killed but they do not germinate. Experiments conducted by Bauer showed that spores of *Bacillus subtilis* and *Bacillus anthracis* were not killed by Kruse and Fischer's colloidal silver chloride.

Buehrman demonstrated that the bacteriostatic action of metallic silver can be neutralized by immersion in a solution of sodium thiosulphate followed by rinsing. He states

The silver salt in combination with the thiosulphate forms the silver sodium thiosulphate with the formula  $\text{NaO}_2\text{S}_2\text{Ag}$  which is transformed into the readily soluble double salt  $(\text{NaO}_2\text{S}_2\text{Ag})_{1/2} \cdot \text{Na}_2\text{SO}_4$ . It very easily dissolves in subsequent rinsing.

In Lieb's experiments which were briefly described in the early part of this paper there naturally was an absence of bacteria on the plate containing the piece of silver saturated catgut, likewise when this piece of catgut was incubated in bouillon for 96 hours there would be no demonstrable growth. This investigator failed to take into account the fact that silver brings about an arrested development of the bacteria within the catgut through the bacteriostatic action of the metal.

**4 Tissue reaction.** The marked leucocytic reaction of abscess like appearance which was observed in the animal experiments which I have described completely refutes the statement of Lihhart that "the silver has an absolutely non irritant action on living tissues" as well as that of Lieb that "the concentration of dissolved (silver) ions cannot have any injurious irritant effect."

The results herein described of embedding silver catgut in living animal tissues are sup-

ported by the work of Jensen and Jensen. In a series of experiments in which they studied the antiseptic action of certain metals, these investigators found that silver oxide possesses a strongly irritant action on the tissues of laboratory animals and human subjects. They also demonstrated that silver chloride combines with, and irritates, the tissues of the experimental animals.

It is claimed that absorption of the silver will take place within the latest 20 to 25 days and after this period the catgut will be absorbed normally like any other catgut. It was this statement that influenced me to select 20 day chromic catgut as control sutures for the animal tissue experiments. Instead of persisting in the tissues for 20 to 25 days as claimed, all sizes of the silver catgut were completely absorbed after 5 days! In other words the large amount of metallic silver in the catgut caused early and severe tissue irritation, with resultant inflammatory reaction and infiltration of cells. Then, the excessive cellular activity of the infiltrated leucocytes hastened the digestion and absorption of the catgut.

#### SUMMARY

Silver catgut, comprising several sizes of sutures was tested for sterility by the same technique as that employed by the Bacteriological Serological Research Institute in the Federal Ministry for Social Administration (Public Health Office), Vienna, wherein sutures are placed for 2 hours in a neutralizing solution of 5 per cent sodium thiosulphate and immediately transferred to nutrient culture medium. Entire absence of bacterial growth after 15 days incubation apparently indicated sterility of the sutures.

Chemical analyses of the sutures revealed the presence of a large quantity (over 2.5 per cent) of metallic silver.

Experiments showed that this large amount of silver could not be removed from the sutures in 2 hours nor in 24 hours by means of a solution of 5 per cent sodium thiosulphate, but that all the silver could be effectively removed by means of a neutralizing solution of 10 per cent sodium thiosulphate, in which the catgut must be incubated for at least 48 hours.

When this special neutralizing solution of 10 per cent sodium thiosulphate was used as a preliminary additional step to my regular bacteriological technique (5), all sizes of the silver catgut were found to be non-sterile

The micro-organisms thus found proved to be spore-bearing bacteria

Three sizes of silver catgut sutures, together

with similar sizes of 20 day chromic catgut of a standard brand which was sterilized by heat, animals were sacrificed at intervals of 3, 5, 8, 12, 20, and 30 days, and a comparative study made of the histological appearance of the tissues. After 3 days, there was almost complete absorption of the smaller sizes of the silver catgut sutures, together with a very marked leucocytic reaction with infiltration of cells of abscess like appearance, while the 20 day chromic control sutures showed entire absence of absorption and almost no tissue reaction. After 5 days, all sizes of the silver catgut sutures were completely absorbed and there was very extensive leucocytic reaction, while the 20 day chromic sutures were well preserved and accompanied by little tissue reaction. After 8, 12, 20, and 30 days there was no evidence of the silver catgut sutures, but the 20 day chromic control sutures showed moderate fibroblastic reaction and were well preserved after having been embedded for 20 days, and could still be identified by a few fragments after 30 days

## CONCLUSIONS

1 The presence of living spore-bearing bacteria in the silver catgut sutures seems to refute the claims of Linnhart that the silver impregnation process destroys "all germs and their spores located in the raw catgut", and certainly disproves the manufacturer's claim that the sutures are "absolutely sterile when manufactured"

2 The technique used by the Bacteriological-Serological Research Institute in the (Public Health Office), Vienna, for testing the sterility of silver catgut, wherein sutures are placed for 2 hours in a neutralizing solution of 5 per cent sodium thiosulphate and immediately transferred to nutrient culture medium,

6 The results herein described of embedding silver catgut in living animal tissues proved conclusively that such sutures were definitely irritating to the tissues, as evidenced by the very marked leucocytic reaction with infiltration of cells of abscess-like appearance which they induced. This condition disproves the statements of Linnhart and also of Jacob to the effect that "the silver has an absolutely non irritant action on living tissues," and "the concentration of dissolved (silver) ions cannot have any injurious irritant effect"

7 The animal experiments herein described showed also that all sizes of silver catgut were completely absorbed after 5 days, thus refuting the claims of the manufacturer that "absorption of the silver will take place within the latest 20 to 28 days and after this period our catgut will be absorbed normally"

8 My research studies of the sterility of silver catgut proved not only that metallic silver does not effectively sterilize catgut, but also that the metal exerts a bacteriostatic action whereby the development of the bacteria within the catgut is arrested. The silver apparently acts on the bacterial colloid in a manner similar to that of copper and mercury by means of an effective neutralizing fluid of 10 per cent sodium thiosulphate for 48 hours reactivates the bacteria which are thus enabled to grow when provided with nutritional support in the form of suitable culture medium

9 The reliability and efficiency of my bacteriological method (5) for testing the sterility of surgical catgut sutures were demonstrated again in this research study of the sterility of silver catgut

10 The fallacy of using such bacteriological technique is twofold. First, my experiments proved that 5 per cent sodium thiosulphate is ineffective as a neutralizing fluid for removing the large amount of silver from the sutures in 2 hours or even 24 hours, and second, transferring the sutures immediately from this neutralizing solution to the culture medium carries the double salt of silver and sodium thiosulphate over into the culture medium where it tends to inhibit bacterial growth

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like any other catgut " These results indicate that the large amount of metallic silver in the catgut caused early and severe tissue irritation, with resultant inflammatory reaction and infiltration of cells, and the excessive cellular activity of the infiltrated leucocytes hastened the digestion and absorption of the catgut

8 Although the purpose of using chemical ("cold process") sterilization for catgut sutures is evidently twofold permitting the use of inferior raw catgut which may yield sutures of fairly good physical properties that would be destroyed by heat sterilization, and eliminating the expensive heat sterilization process, nevertheless, since it is possible so easily to procure heat sterilized catgut sutures that possess all surgical requisites, I can see no place for chemically sterilized sutures with their resultant uncertain sterility

9 A careful study of the results of my bacteriological examinations of silver catgut sutures serves to emphasize the importance of two conclusions set forth in a previous paper (4) "(1) *The so called chemical sterilization of surgical catgut by any method yet devised is inefficient and unreliable* (2) *Carefully controlled heat sterilization is the only uniformly reliable and positive method of sterilizing surgical catgut sutures*" Hence the desirability of using an approved well known brand of heat sterilized sutures should be quite evident

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# AN EIGHT YEAR SURVEY OF CESAREAN SECTIONS AT

## THE WILLIAM H COLEMAN HOSPITAL

GERALD W GUSTAFSON, M D, F A C S, Indianapolis, Indiana

THE William H Coleman Hospital was formally dedicated by an address by Dr Palmer Rindley in October, 1927. The institution was founded by the donor for the care of obstetrical and gynecological patients at Indiana University. This material for this survey includes all cesarean sections done at this institution from its origin up to January 1, 1936, a period of 8 years and 2 months. The number of available beds for obstetrics is ward, 27 beds, private floor, 12, while 4 patients can be cared for in the isolation unit.

Maternal mortality in cesarean section depends upon several factors and if our national mortality rate is to be lowered, it is probable that study of these factors in individual institutions as well as community statistics, may point the way to lower national figures. Particularity is this so, if tremendous mortality figures have been greatly improved by facts easily discernible by study of these statistics. Among the factors involved in cesarean section mortality in an institution are the personnel of the staff, the maternal of the individual institution, the incidence of cesarean section, and the types of operations performed. It, over a period of years, the first three factors remain largely unchanged and the mortality rate is greatly lowered by the wider adoption of safer types of operation, it would only be reasonable to assume that the same would apply to national mortality rates.

The active staff of the Coleman Hospital has been composed of men trained at various institutions, such as New York Lying-in, Boston Lying-in, Chicago Lying-in, Presbyterian Hospital of Chicago, etc. It is only natural that viewpoints at times have been at variance. Of the total of 366 sections done during this period, not including one post-cesarean, the Department of Obstetrics Indiana University Medical School

vised by members of this staff. Each year between 1000 and 1500 cases have been delivered in this service. Some of the patients with pathological condition from this service have been sent to the Coleman Hospital, but the greatest number have gone to the Indianapolis City Hospital. Though the inclusion of these figures would greatly reduce our incidence of cesarean section, they cannot be rightfully included. However, it must be emphasized that this service is a university service and is supervised by members of the Coleman Hospital staff.

The incidence by years of cesarean sections in the hospital cases is as follows:

TABLE I—INCIDENCE OF CESAREAN SECTIONS

Year	Sections	Cases	Incidence	Percentage
1927 (2 months)	5	81	1 10 2	6.1
1928	33	679	1 20 5	4.7
1929	32	854	1 7	3.6
1930	47	1008	1 23 3	4.2
1931	62	1101	1 17 7	5.6
1932	53	869	1 10 7	5.9
1933	44	8 6	1 19 4	5.1
1934	43	910	1 21 1	4.7
1935	48	915	1 19	5.2

Total incidence 4.8 per cent

#### MATERNAL MORTALITY

At the start of the institution one of the other staff members and the author were convinced of the superiority of the low cervical section or laparotrachelotomy. Through association with Dr. DeLee at the Chicago Lying in Hospital the author believed that it was the operation of choice, my colleague from the New York Lying in had probably been convinced indirectly by the teaching of Dr. Beck. However, much as we tried, we could not 'sell' the other members of the staff. Strange as it may seem, the man who did more than anyone else to lower our maternal mortality rate was not a member of the staff but he visited us demonstrated the transverse cervical cesarean section, and succeeded in convincing the staff while we who believed in the superiority of low cervical cesarean had failed to do so. I refer to Dr. Louis Phaneuf who visited the institution in 1931. Previous

to 1931 there had been 117 sections with 13 deaths, a mortality rate of 11.1 per cent. Following this and including 1931 to January 1, 1936, there were 250 sections with 12 deaths, a mortality rate of 4.8 per cent or not including 1931, there was a mortality rate of 3.7 per cent for the 187 sections in the years 1932, 1933, 1934, and 1935.

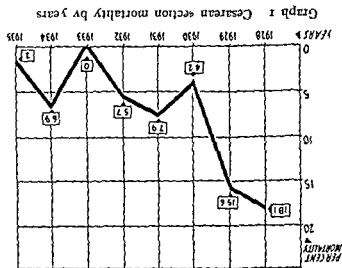
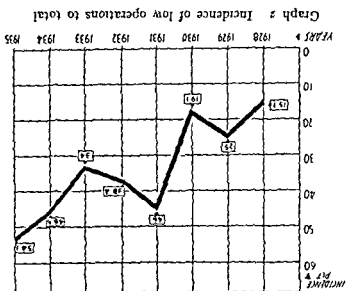
TABLE II—TOTAL SECTIONS

Year	Total sections	Brod head	Classic	Laparotrachelotomy		Porro
				Longitudinal	Transverse	
1927	5		2	3		
1928	33	1	27	5		
1929	32		24	8		
1930	47		36	9		2
1931	62		33	7	22	1
1932	53		32	4	17	
1933	44		29	7	8	
1934	43		22	5	16	1
1935	48		26	5	17	2
Total	106	1	226	47	88	5

TABLE III—MATERNAL DEATHS

Year	Classic	Brodhead	Laparotrachelotomy		Porro
			Longitudinal	Transverse	
1927	0	0	0	0	0
1928	4	2	1	0	0
1929	6	0	1	0	0
1930	2	0	0	0	0
1931	4	0	0	0	0
1932	3	0	0	1	0
1933	0	0	0	0	0
1934	3	0	0	1	0
1935	0	0	0	1	0
Total	19	2	2	3	0
Mortality per cent	8.4	100	4.2	3.6	0

Table II shows the various types of sections done during this period. The one operation designated as Brodhead was a peritoneal exclusion operation with attempt to wall off the peritoneal cavity by suture of the parietal peritoneum to the uterus before incision into the latter. The classic operations for the most part were low classic operations with the



the incidence of low cervical operations to total cesareans for the same years. In general it will be seen that as the percentage of low cervical operations increased, the percentage of cesarean deaths decreased.

#### INDICATIONS

Table IV gives the various indications for cesarean section in this group of cases and a study of the most frequent indications is of especial interest.

*Contracted pelvis or cephalopelvic disproportion.* For this indication, section was done 126 times. Almost invariably in these cases, a trial labor was resorted to. The duration of labor varied considerably. However, there were few cases in which patients were permitted to go to complete dilatation, the usual

abdominal incision below the umbilicus. The longitudinal low cervical operations were that type advocated and described by DeLee and Beck. The transverse low cervicals were all done with the Phaneuf technique. By adherence to this technique there was no difficulty encountered in the approximation of the upper uterine flap to the lower such as found by Stein and Leventhal in the operations performed at Michael Reese Hospital of Chicago. Especially in those cases where the lower uterine segment was not distended by the presenting part, occasionally increased bleeding over the longitudinal incision was encountered. This type operation seems to have a distinct advantage over the longitudinal incision in those cases having very short lower uterine segments and is especially satisfactory in many cases of the elective type in which the lower uterine segment is not fully developed. As the author sees it, it is always preferable to have the entire uterine incision in the lower

uterine segment. Table III gives the maternal deaths according to years and the type of section employed. There is no corrected mortality. It can readily be seen that in this series, the maternal mortality in the low cervical type section has been less than half that of the classic section in spite of the fact that the low cervicals were done for the most part on far poorer risks than the classics. Graph 1 shows the cesarean section mortality according to years while Graph 2 shows

TABLE IV—INDICATIONS

Indication	Number of cesarean
Contracted pelvis	126
Previous section	99
Placenta previa	29
Non convulsive toxemia	35
Eclampsia	17
For sterilization	9
Heart conditions	8
Cervical dysplasia (1 carcinoma of cervix)	5
Abruptio placentae	5
Ruptured uterus	3
Previous dyslocia	3
Protruded cord	14
Fetal distress	2
Previous plasies	4
Toxic goiter	2
Miscellaneous	7

TABLE V.—SECTIONS FOR CONTRACTED PELVIS  
(TEST OF LABOR)

	Classic		Laparotrachelotomy			
			Longitudinal		Transverse	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Private floor	39	2	17	1	16	1
Ward	15	3	13	1	25	0
Total sections	55	5	30	2	41	1
Mortality per cent	9.1		6		2.4	

Total low cervical mortality—4.2 per cent

custom of Danforth. Many times we have seen delivery take place from below after a trial labor, when if we were doing elective cesarean section because of pelvic contraction, abdominal delivery would have been resorted to. This indication also included 14 cases of breech presentation, 3 cases of face presentation with chin posterior and 1 brow presentation. Occasionally increase in size of babes may make it necessary even to perform sections in multiparae. For instance, in Case 9410 patient had had three babes, weighing respectively 7, 9, and 9 pounds. This time the patient was given a complete test of labor to complete dilatation of the cervix and yet there was marked overriding and the head would not enter the pelvis. This babe was 57 centimeters long and weighed 10 pounds and 3 ounces. This case was the author's and cesarean section was not resorted to until even after artificial rupture of the membranes engagement did not occur.

Though the pelvic inlet can be accurately measured by means of the newer x ray methods, still we are unable to forecast accurately the type of pain that the patient will have or the moldability of the babe's head. Given two borderline pelvises of the same dimensions and with the same size babes, one may deliver through the normal canal while for the other, that route would be an impossibility. In our experience, pelvis with enough contraction of the outlet to warrant cesarean section are few and far between.

It is now conceded by most authorities that to do classic cesarean after a trial labor, even though it be conducted properly without vaginal examination, is a very dangerous

procedure. At the Coleman Hospital it has been shown that the low cesarean section is a much safer procedure in cases of this type. In fact much of the high mortality for the first 2 or 3 years of the hospital's existence was due to failure to use the safer methods in cases having had test of labor (Table V).

Twenty multiparae were in this series. Eight secundiparae had lost their first babe at delivery. A quadripara had lost all previous babes at delivery. The others were subjected to cesarean section because of the size of the babes. In 3 cases, all primiparae, forceps had been applied before patients were admitted to the hospital but the babes were in good condition. The low cervical mortality of 4.2 per cent when compared with 9.1 per cent for classics leaves no doubt as to the better operation in patients having had tests of labor (Table VI).

*Previous section.* With the incidence of rupture of the uterus after classic section, about 4 per cent, we have felt that especially in patients having had classic section, cesarean section was the safest procedure in those patients never having had a babe through the normal canal and especially so if the section had been performed for contracted pelvis or if a definite wound infection followed. We know of no way to evaluate the strength of the uterine scar before operation. This group is typical of the elective section cases. No patient had had more than two previous sections.

As given in Table VII, 20 patients who had low cervical operations at repeat sections lived while of the 79 who had classic sections, 3 died. Elective section should have a very low mortality, yet it must be realized that definite increased risk is taken over delivery from below. Of the 99 patients in this group 60 were sterilized—resection of the proximal end of the tubes and a wedge of the uterine cornu was the method usually employed.

No adhesions were noted in patients having previously had low cervical operations, while many of those having had classic sections showed dense, thick adhesions.

The patient who died from intraperitoneal hemorrhage had had a previous transverse cervical operation. At autopsy the scar of



TABLE VI—HOURS OF TRIAL LABOR, 41

(ELECTIVE)

TABLE VII—INDICATION—PREVIOUS SECTION

Ward	Deaths	Private floor	Deaths	Embolism	Hysterical obstruction postoperative hemorrhage
31	1	28	2	0	0
4	0	0	0	0	0
8	0	0	0	0	0
25	0	0	0	0	0
8	0	0	0	0	0
29	0	0	0	0	0

TABLE VIII—PLACENTA PREVIA

Private floor	Classic	Longitudinal	Transverse	Total
3	2	1	0	4
15	1	2	8	25
18	3	3	8	29

There were 3 maternal and 3 fetal deaths

this operation was just visible In Case 555 the author performed a third section, longitudinal laparotomectomy This patient had previously had one classic section and one longitudinal low cervical section The scar of the latter operation was barely perceptible while the fundal scar of the previous operation was depressed and thin

*Placenta previa* Most obstetricians agree that in a patient at term but not in labor, who has a placenta previa of the central or lateral type and a thick undilated uneffaced cervix, it is safer to effect delivery by cesarean section On the 29 sections during this period for placenta previa, 7 were primiparae, the others multiparae, 1 a nonpara, 1 a decipara, and 1 an undecipara Other multiparae were treated by bag, Braxton Hicks version, or internal podalic version Table VIII gives the results of cesarean sections done for placenta previa

One patient on private floor was admitted in shock and bleeding very profusely A classic section was done and the patient died of peritonitis The other death on private floor was due to a postpartum hemorrhage 3½ hours after she returned to her room The ward patient died from septicemia after she had had a classic operation Bill has pointed out the importance of transfusion and the dangers of postpartum hemorrhage in placenta previa and has called attention to the lessened tendency to postpartum hemorrhage in those patients treated

TABLE VI—HOURS OF TRIAL LABOR, 41

RECORDED

Case number	Hours	Type section	Highest temperature	Deaths	Private floor	Deaths	Embolism	Hysterical obstruction postoperative hemorrhage
386	3	Classic	101	0	0	0	0	0
1043	5	Classic	101	0	0	0	0	0
6875	6	Classic	100	0	0	0	0	0
161	12	Longitudinal low cervical	100	0	0	0	0	0
1717	12	Classic	104	0	0	0	0	0
5575	7	Transverse cervical	100	0	0	0	0	0
4526	10	Classic	101	0	0	0	0	0
3485	12	Transverse cervical	101	0	0	0	0	0
555	18	Longitudinal low cervical	101	0	0	0	0	0
10310	21	Transverse cervical	101	0	0	0	0	0
8050	22	Longitudinal low cervical	101	0	0	0	0	0
3400	24	Longitudinal low cervical	104	0	0	0	0	0
751	24	Classic	101	0	0	0	0	0
503	24	Longitudinal low cervical	103	0	0	0	0	0
1461	20	Classic	104	0	0	0	0	0
5242	22	Transverse cervical	101	0	0	0	0	0
4033	24	Transverse cervical	102	0	0	0	0	0
5921	19	Transverse cervical	101	0	0	0	0	0
5280	22	Transverse cervical	105	0	0	0	0	0
8465	18	Transverse cervical	102	0	0	0	0	0
2408	20	Classic	101	0	0	0	0	0
3199	20	Longitudinal low cervical	103	0	0	0	0	0
2215	10	Longitudinal low cervical	104	0	0	0	0	0
1833	11	Classic	104	0	0	0	0	0
2038	30	Longitudinal low cervical	105	0	0	0	0	0
2215	30	Longitudinal low cervical	104	0	0	0	0	0
3056	48	Classic	103	0	0	0	0	0
1008	35	Transverse cervical	100	0	0	0	0	0
450	35	Transverse cervical	101	0	0	0	0	0
306	48	Longitudinal low cervical	103	0	0	0	0	0
915	38	Transverse cervical	101	0	0	0	0	0
1627	38	Transverse cervical	103	0	0	0	0	0
2076	30	Transverse cervical	103	0	0	0	0	0
5184	35	Classic	103	0	0	0	0	0
1502	35	Transverse cervical	105	0	0	0	0	0
7720	36	Transverse cervical	103	0	0	0	0	0
6847	38	Transverse cervical	102	0	0	0	0	0
5496	33	Transverse cervical	104	0	0	0	0	0
1509	62	Transverse cervical	101	0	0	0	0	0
622	34	Transverse cervical	103	0	0	0	0	0

Of 45 hours

24 to 48 hours

12 to 24 hours

6 to 12 hours

0 hours or less

(Block performed 16 days)

by cesarean section. The patient who died of postpartum hemorrhage after section was not packed at the time of operation. This should always be done in cases of abruptio placenta and placenta praevia.

Whenever a patient with placenta praevia comes to the ward, she is immediately taken to the delivery room. Blood is drawn for typing and fluid is given intravenously if necessary. One room is set up for cesarean section and the other for delivery from below, insertion of bag, etc. The procedure to be carried out is determined only after a careful vaginal examination to determine the state of the cervix and the degree of praevia. The practice of omitting the vaginal examination is to be condemned because occasionally a patient at term will have bleeding from the vagina especially if labor is just starting without the presence of placenta praevia. A vaginal examination will save these women from unnecessary cesarean section.

The possibility of placenta accreta or increta with placenta praevia should always be borne in mind. If the condition exists to any extent, the uterus must be removed.

**Non convulsive toxemia.** Cesarean section has been reserved for those cases of fulminating pre-eclampsia not responding or rapidly growing worse under conservative treatment. Consultation between two or more staff members was had in most cases before section was done. Decision to operate was largely made on the clinical picture though blood chemistry, especially uric acid determination and carbon dioxide combining power was often helpful. We feel that we have saved lives by doing cesarean sections on primiparae not in labor and having thick, closed cervices, who were rapidly growing worse on conservative treatment. In this condition local anesthesia is the anesthetic of choice. In this series 35 sections were done for this indication with 1 death. The death was in a patient with recurrent toxemia. She was a quadripara who had had convulsions in each of her former pregnancies. At about 8 months she appeared in the prenatal clinic with a blood pressure of 170/110 and with only a trace of albumin. A low classic section and sterilization was done under local anesthesia. The patient went into

coma and died within 48 hours. The most noteworthy findings at autopsy were pulmonary edema and marked perportal necrosis of the liver.

Table IX shows results as to type of operation. In 6 cases local infiltration anesthesia was used, 1 spinal anesthesia, and in the remainder nitrous oxide oxygen supplemented by ether.

TABLE IX.—INDICATION—NON-CONVULSIVE TOXEMIA

	Classic	Longitudinal	Laparotomomy Transverse
Private floor	12	3	6
Ward	12*	0	2

\*1 death

**Eclampsia.** Conservative treatment is the treatment of choice after convulsions or coma. Occasionally in desperate cases rapidly growing worse, we have employed local cesarean section. In a few cases in which the patient was moribund and there was a reasonable chance of getting a live babe, section was done in the interest of the babe. As usual with this indication, mortality has been tremendous and yet occasionally a patient who seemed surely destined to die, would live.

TABLE X.—INDICATION—ECLAMPSIA

	Classic Cases	Deaths	Transverse Cases	Cervical Deaths
Private floor	6	1	0	
Ward	9	{ 3 mothers 2 babes	2	{ 1 mother 1 babe

**For sterilization.** It is a much safer procedure to sterilize, when indicated, 3 to 6 months after delivery. Many times however, it has been our experience that often these patients will return pregnant again before the operation can be performed. Cesarean section was done for sterilization with no other indication, nine times. Indications for sterilization were chronic nephritis, severe hydronephrosis, active pulmonary tuberculosis, epilepsy, and mental deficiency. Fortunately no deaths occurred from this questionable procedure.

**Organic heart disease.** Because of heart disease section was done 9 times and 3 deaths followed. In all the deaths mitral stenosis was present. One patient died with lobar

ure. All patients with heart disease had the benefit of consultation by a cardiologist.

*Abruptio placentae* Patients with severe types of abruptio placentae were subjected to cesarean section. There were 5 cases. All mothers lived and all babies died except in 1 instance in which live twins were delivered.

This patient was in labor in the ward when the classical picture of abruptio placentae occurred. One of the staff was in the hospital at the time and the patient was immediately subjected to cesarean section.

*Retroplacental hemorrhage* In 5 instances fibroids blocked the birth canal, and cesarean section was done in all 5. Two of the operations were Porto and three were classic. One patient succumbed in this series, and it is probable she could have been saved by the Porto operation. In spite of the fact that pus was present in the abdominal cavity from a degenerating fibroid, a classic section was done and the patient died of peritonitis.

*Ruptured uterus* As far as we know, none of our sections has ruptured. However, in this 8 year period we have had 3 cases of rupture of the uterus. One was a rupture at the site of the scar in a patient who had had a classic operation. The second case was a patient who had had a normal delivery and later a cesarean section by an outside surgeon. The third case was one of spontaneous rupture in a scar when attempt at forceps delivery had been made and pituitrin had been given. All mothers recovered and all babies were stillborn.

#### MATERNAL DEATHS

Listed below are brief notes taken from the charts of all patients dying after cesarean section.

- 1 Case 684, Primipara, ward, aged 25 years, had a classic section after a trial labor and with men-  
branes ruptured for several hours. She died of  
peritonitis on the fourth day.  
2 Case 809, Quadripara, private, aged 39 years, had a classic section because of central placenta previa. A postpartum hemorrhage started 20 minutes after she was returned to her room. She died 3 hours and 35 minutes after delivery.  
3 Case 1015, Primipara private, aged 34 years, had an elective classic cesarean section because of a  
section and died of lobar pneumonia.

4 Case 2883, primipara, private, aged 33 years, upon whom a classic section was done after 30 hours of labor and a vaginal examination, died with  
paralytic ileus.  
5 Case 4157, secundipara, ward, aged 26 years, had lost her first babe at delivery. A longitudinal low cervical operation was done after trial labor. Operation was an hour in duration. While closing the abdominal patient stopped breathing without signs of circulatory failure. All efforts at artificial respiration failed although the heart continued strong for several minutes. No autopsy permitted. Death was evidently caused by the anesthetic.  
Mortality for 1929, 15.6 per cent.

1930

The patient died of infection and myocardial failure. The incision opened after operation necessary. The incision closure including peritoneum and uterine necrosis at the time of incision.  
5 Case 1190, secundipara, private, aged 47 years, was operated upon after 4 days' trial labor, with low cervical section was done and the patient died of peritonitis.  
6 Case 2007, secundipara, private, had cesarean section 2 days after an attempted bag induction. The first babe had been lost in a forceps operation and this time the fetal heart had gone to 170. A broadhead type of peritoneal excision operation was done. Patient died of peritonitis and thrombophlebitis with embolism.  
Mortality for 1930, 18.1 per cent.

1932

1 Case 4598, primipara, ward, aged 27 years, was admitted in a moribund condition. She had not attended a prenatal clinic and had had several convulsions before admission. An antemortem classic section was done. Patient was cyanotic, chest was filling with mucus, pulse was 140, and temperature, 104 degrees. She died of eclampsia.  
2 Case 3497, secundipara, private, had delivered her first babe from below. Her doctor called a general surgeon who immediately did a classic section under ether anesthesia. She died of eclampsia.  
3 Case 4190, secundipara, private, aged 29 years, had a termic hemorrhage from placenta previa before a classic section was done. A classic section was done and the patient died of peritonitis and pulmonary embolism.  
4 Case 2883, primipara, private, aged 33 years, upon whom a classic section was done after 30 hours of labor and a vaginal examination, died with  
paralytic ileus.  
5 Case 4157, secundipara, ward, aged 26 years, had lost her first babe at delivery. A longitudinal low cervical operation was done after trial labor. Operation was an hour in duration. While closing the abdominal patient stopped breathing without signs of circulatory failure. All efforts at artificial respiration failed although the heart continued strong for several minutes. No autopsy permitted. Death was evidently caused by the anesthetic.  
Mortality for 1932, 18.1 per cent.

2 Case 5626, primipara ward, aged 18 years, had an elective classic section because of placenta prævia and toxemia. She developed eclampsia and died of septicemia. The *Staphylococcus aureus* was found in the blood cultures.

Mortality for 1930 was 4.2 per cent

#### 1931

1 Case 9796, secundipara, ward, aged 44 years was subjected to cesarean section because of disproportion plus a pre eclamptic toxemia. Blood pressure was 180/115 with marked edema and headache. A classic section was done and the patient died on the tenth day after operation with pulmonary embolism demonstrated at autopsy.

2 Case 9397, quadripara ward, aged 37 years was admitted with recurrent toxemia. She had had convulsions with all previous pregnancies. Blood pressure was 170/110, albumin trace was noted. A classic section and sterilization was done under local anesthesia. Patient went into coma and died 2 days later. Autopsy showed marked periportal necrosis of the liver and atheroma of the aorta.

3 Case 9393, quintipara ward, aged 32 years had an elective classic section and sterilization was done because of myocarditis and mitral stenosis. She died 10 days after section with pulmonary edema and heart failure.

4 Case 8459, septipara ward, aged 36 years. Patient was admitted to hospital in deep coma with eclampsia. She had had 8 or 10 convulsions and urine showed albumin 4 plus. The doctor who sent her first saw her in convulsions. She was seen by 3 staff men. A transverse section was done under local anesthesia. She died of toxemia and bronchopneumonia.

5 Case 8498, primipara ward, aged 18 years was admitted in comatose and cyanotic state. She had had several convulsions. She was a prenatal patient. Monday of admission patient had done a large washing. A classic cesarean section was done. Patient died of toxemia.

Mortality for 1931 was 7.9 per cent

#### 1932

1 Case 86, primipara ward, aged 32 years had 26 hour trial labor with no engagement. The birth canal was blocked with 3 large fibroids. A classic section was done. Pus was found in the abdominal cavity from a degenerating fibroid. A fibroid the size of a baseball was excised from the uterus. Patient died of peritonitis.

2 Case 11302, tripara ward, aged 38 years. Patient entered hospital in coma. Blood pressure was 195/125, non protein nitrogen 47, albumin 3 plus. A classic section was done after 6 hours of labor and after the membranes had been ruptured artificially. Patient died of eclampsia.

3 Case 11138, secundipara ward, aged 28 years had had previous section for disproportion. A classic section and sterilization was done. Patient died 3 hours later with pulmonary embolism.

Mortality for 1932 was 5.7 per cent

#### 1933

No maternal deaths

Mortality for 1933 was nil

#### 1934

1 Case 5638, primipara, private, aged 23 years, was referred to one of the staff by an outside doctor. Forceps had failed to produce results in the home with prolonged chloroform anesthesia. Pituitrin had been given. A transverse cervical cesarean was done. Patient died of infection plus acute yellow atrophy. No autopsy was obtained.

2 Case 5548, quadripara, private, aged 31 years, had had two previous sections. Elective classic section plus sterilization was done. Patient died after 25 days with intestinal obstruction and lobar pneumonia.

3 Case 5208, secundipara, private, aged 20 years had had previous transverse cervical cesarean section. The operator chose the classic section. The patient died 4 hours later from postpartum hemorrhage. At autopsy 800 cubic centimeters of blood was found in the abdomen.

Mortality for 1934 was 6.9 per cent

#### 1935

1 Case 9347, primipara, private patient of the author's, aged 27 years, had mitral stenosis of long standing. There had been good compensation throughout pregnancy. After 12 hours of labor, patient went into decompensation. A transverse cervical cesarean was done, and live babe delivered. Mother died in 12 hours of heart failure. Patient had been seen throughout pregnancy and labor by a cardiologist.

Mortality for the year 1935 was 4 per cent

### MORBIDITY

Morbidity is defined in most medical dictionaries as the state of the patient, or degree of sickness, or condition of being diseased. According to present standards, the temperature alone is taken to express this. In cases of infection this is probably the best index as to the condition of the patient. In hemorrhage certainly the hemoglobin determination would be more indicative of the true state while in the toxemias blood pressure readings and quantitative albumin determinations would offer more indication of the patient's condition. It is well known that many patients go through their stay in the hospital with normal temperature and yet are left in terrible condition, gynecologically.

The standard adopted by the American Committee on Maternal Welfare considers normal any rise in temperature above 100.4

TABLE VI—TEMPERATURE RANGE

		100 or below		Cases Per cent					
		100-	101-		102-	103-	104-	105-	106-
Classic	24	10	6	65	69	31	18	18	
Longitudinal low cervical	5	10	6	13	11	11	3	5	
Transverse	12	13	15	22	29	15	5	5	
Pure	0			1	1	1	0	2	
Woodhead	0				0	1	0	0	

degrees on any 2 days, exclusive of the first 24 hours, oral temperature taken every 4 hours. Yet a patient may come under this standard of normal and yet have been close to death.

For instance Case 9371 was a severe pre-eclamptic whom I saw in consultation after she had had 1 week of conservative treatment

she was becoming worse in spite of initial venous glucose and sedation as she was a

primipara about 2 weeks from term with a closed thick cervix, cesarean section was done. The operation took about 45 minutes and

there was very little blood loss, a longitudinal laparotomachotomy being done. Shortly afterward she went into severe collapse, with cold

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perceptible radial pulse. Fortunately, she responded to treatment and after the first 24 hours, never had a temperature up to 100 degrees. I have never seen a patient whose

to death, and yet she would not be recorded as being morbid by the standard advocated by the American Committee on Mental

In this series of cases, rectal temperatures

temperatures, including the first 24 hours. In Table XI is given the range of

times without gloves or after attempts at delivery from below. If the babe is alive and apparently in good condition with the pelves so contracted that delivery of a live babe from below is impossible, the Forro operation would seem to give greatest protection to the mother, not only because of removal of the infected organ but also because of ligation of the uterine vessels. The only case of peritoneal exclusion operation or marsupialization in this series died. Recently in another it was done with the peritoneum and fascia sutured to the uterus before incision into it. This patient recovered after a stormy puerperium. Whether the Latzko operation is safer than the laparotracelotomy in these cases is still questionable. The initial spill is probably

TABLE VIII—CAUSES OF DEATH

Prost head	Porro	Classic	Tang- nui verse	Laparotracbe lotomy	31	2	2	16	1	
					Myelitis					
					Pneumonia	1	1	2	4	
					Peritonitis	6	1	4		1
					Hivoid infection	11	1	4		
					Stenosis	2	2			
					Colonar pneumonia	6	3*	3		
					Brachyopneumonia	3	2*	1		
					Pleurisy	1	1	1		
					Epiphric abscess	2	1	1		
					Empyema	1	1	1		
					Emphysematous embolism	2	2	2		
Brachitis	4	1	3*							
Hypertibproudism	3	1	1							
Dechi drachin	1		1							

TABLE VII—CAUSE OF MORBIDITY (81 CASES)

not the greatest factor as we know the peritoneum will usually stand one severe insult but with repeated insults, peritonitis will often occur, for instance, in classic sections with the uterine incision infected and leaking. The author is inclined to believe that he would rather trust the resistance of the lower peritoneum to an infectious spill than to trust the resistance of the pelvic connective tissue. It is probable that infection after cesarean often originates from an endometritis, the infection continuing to the uterine incision, and then to the peritoneum. Certainly these cases are minimized in the low cervical operations.

TABLE XIV—FETAL MORTALITY

Indications for section	Babies died
Previous section	2
Placenta prævia	1
Non-convulsive toxemia	2
Eclampsia	3
Abruptio placenta	4
Prolapsed cord	1
Ruptured uterus	3

As there were 6 sets of twins delivered in this series, the total of babies were 372, which with 18 deaths gives a fetal mortality of 4.8 per cent.

## SUMMARY

All cesarean sections from the start of the Coleman Hospital in October 1927, to January 1, 1936, have been reviewed. There has been no great change in incidence during this period, the lowest incidence for a full year being 3.6 in 1929, and the highest 5.9 in 1932. Incidence for the entire group is 4.8 per cent. During this period the staff has been largely unchanged. The material is largely pathological and has been unchanged in character. There has been a marked increase in the incidence of low cervical cesarean section or laparotrachelotomy since 1931. Accompanying the increased incidence of this type operation there has been a decided drop in maternal mortality from cesarean section. Maternal mortality from cesarean section before 1931 was 11.1. Doctor Phaneuf's visit was in 1931. For the years 1932, 1933, 1934, and 1935 the mortality rate was 3.7 per cent. The mortality rate for all classic operations during the 8 year period was 8.4 per cent. The rate for all low cervical sections, including longitudinal and transverse incision was 3.7 per cent.

The most frequent indication was contracted pelvis. Most of these cases had the test of labor. The next most frequent indication was previous section and practically all of these were elective sections. For the indication, contracted pelvis, classic section gave a mortality of 9.1 per cent and low cervical 4.2 per cent. For the indication, previous cesarean section, 16 elective cases, there were no deaths in 20 cases having low cervical operations while there were 2 deaths in 79 classic operations, a mortality for the classic of 3.7 per cent. For placenta prævia there were 18 classics with 3 deaths and 11 low cervicals with no deaths. For non-convulsive toxemia there were 35 sections with 1 death, while in eclampsia there were 17 sections with 5 deaths. Five cases of abruptio placenta were sectioned and all recovered. Three cases of rupture of the uterus recovered. The most frequent cause of morbidity was pyelitis. The most frequent cause of mortality was peritonitis and infection. The fetal mortality was 4.8 per cent.

## CONCLUSIONS

1 The greatest single factor in the reduction of cesarean section mortality at the Coleman Hospital, has been the wider adoption of low cervical cesarean section.

2 The low cervical operation is safer than the classic, not only in cases of patients having had tests of labor but also in elective cases. In the latter type patient and in other patients having short lower uterine segments, the transverse incision with the Phaneuf technique is a very satisfactory procedure.

3 By study of these statistics, it is only reasonable to assume that if low cervical operations could be substituted for the classic operations in this country, the mortality from abdominal deliveries would be cut in half, a prediction made by DeLee in the 1933 *Text Book of Obstetrics and Gynecology*.

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## RENAL TUBERCULOSIS

With Special Reference to Follow-Up Results in the Squier Clinic

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**D**URING the 7 year period from January 1, 1928, to January 1, 1935, in the Squier Urological Clinic, 96 tuberculous kidneys were removed at operation. The present study was primarily undertaken to determine the status of these patients at the present time by reviewing the follow-up reports. Our study in turn led to a complete analytical summary. The conclusions reached under the usually accepted headings in such analyses vary but little from similar reports of other clinics, and will therefore be only briefly noted. The follow up results, death analyses, and the presentation of a few unusual cases are given special attention as being of possible value in the study of this subject.

**Sex.** Of 96 patients, 56 were males, 40 were females.

**Operation.** The right kidney was removed in 50 cases, the left in 46 cases. Complete ureterectomy was done only 3 times.

**Age.** The youngest patient was 13 years, the oldest 76 years.

Age in years	Cases
Less than 20	9
20 to 29	18
30 to 39	38
40 to 49	16
50 to 59	11
60 to 69	3
70 to 80	1

**Race.** There were 53 Gentiles, 22 Jews, 3 Negroes, 16 Italians, 1 Mexican, and 1 Chinese. This incidence probably represents a cross section of our clinic rather than individual susceptibility to the disease.

**Symptomatology.** Frequency of urination was noted in 74 instances, the duration varying from days to years. Those without this symptom usually had a very early lesion or a blocked kidney. Urgency and dysuria were as a rule present in advanced lesions of the bladder.

Pain was noted in 37 cases. This was more than we had expected judging from our general impression and from other reports on this subject. For the most part pain was localized in the flank but 4 patients experienced a radiation of the pain in the groin similar to that seen in renal colic.

**Hematuria** was mentioned by 37 patients. From the follow up study of these cases, this symptom had no prognostic value except where bleeding occurred from very early lesions. In these cases the hematuria led to an early nephrectomy before much renal or bladder involvement had occurred. For example, 2 patients were referred on account of red blood cells being found in routine life insurance examinations of the urine. Both have perfect follow up results 4 and 5 years after nephrectomy.

**Cystoscopic findings** before pyelography suggested tuberculosis to the examiner in 86 cases.

**Pyelograms.** Where obtainable, pyelograms were diagnosed as tuberculosis 73 times. In the earlier years of this study we did not have the use of intravenous pyelography. The number of destroyed or dead kidneys, where we could not pass a catheter by a ureteral block or where the intravenous injection of skiodan or diodrast gave no shadow, was 21. In view of this fact the next caption is interesting, and satisfactorily so to this clinic.

**Tubercle bacilli in the urine** were found microscopically where separate kidney specimens were obtained in 68 of 70 possibilities. Of the 2 specimens in which the bacilli were not found 1 was in a patient with an early lesion which gave no symptoms. The other was in a tuberculous kidney composed mostly of fat replacement and no cavities. Our experience with this method of determining the presence of the tubercle bacillus in the urine has been so uniformly good that guinea pigs are no longer used. In the cases in which kidney specimens were not obtainable the diagnosis was made



from the history, cystoscopic appearance of the bladder, and by pyelograms, intravenous or retrograde

*Co-existing external tuberculosis* was found in the lungs of 17 cases, in the epididymis in 9 cases, in the spine in 2 cases, of the hip, 2 cases, there was 1 patient in whom the breast and sternum were involved

*Pathological diagnosis* Examination of the removed kidneys showed 21 to be destroyed and functionless. There showed diffuse changes with tubercles but no cavitation. Three showed only small early cavities, 3 were made up mostly of fat replacements, in 3 cases calcification was present. In a patient 76 years old the kidney was greatly atrophied and showed some healing. There were 2 cases of tuberculosis in embryonic kidneys. There was one lesion in one half of a double kidney. One caseous lesion was in a kidney which also showed a large solitary cyst. One kidney had an area of solid calcification 3 by 4 centimeters in diameter. This was reported as tuberculosis by the pathologist although the history and physical findings were negative. This patient came to operation only because of the shadow of this lesion having been found in routine gastro intestinal x-ray examinations. The remaining kidney showed the usual changes with cavity formation.

*Death analyses* Of 66 patients operated upon during this 7 year period, 11 are known to be dead. There were 8 patients who died in the hospital, 3 of these died, 1, 1, and 3 years, respectively, after operation, on being readmitted to the clinic. Five deaths must be included under operative mortality, of these 1 died of pneumonia on the eighteenth day after operation, 1 died 42 days after operation of renal insufficiency, the remaining kidney was found to be hydropneumothoracic at autopsy. One patient died 48 days after operation of military tuberculosis. One died 49 days after operation of bronchopneumonia, the wound was markedly infected and showed no tendency to heal. One died 184 days after operation, this was a young colored woman. Her operative wound opened widely a few days after necropsy, and at no time showed any tendency to close, despite sun and light treatments. On the one hundred and sixty-eighth day a

Of the 3 patients who died in the hospital on readmission, 2 were known to have bilateral lesions, and operation was done only in an attempt to make them more comfortable. One, a young Jewish man of 27 years, had a right nephrectomy despite a known infection of the left kidney and of the lung. He was definitely more comfortable for 6 months after this operation, then he suffered pain in the left side and had a generalized edema and died approximately 1 year after the operation from a generalized tuberculosis including a terminal meningitis. The other case in which nephrectomy was done for palliative purposes only, was an Italian male of 32 years. He gave a history of hematuria of 3 years' duration, his right kidney was destroyed, his left specimen showed tubercle bacilli but the function and the pyelogram were apparently normal. After removing the right kidney he did not improve even temporarily. He lived 3 years and 1 month after his operation. The history of the last patient who died in the hospital is of unusual interest because autopsy showed tuberculosis of the adrenal gland, the only instance of this lesion in this series.

The patient was a Negro male of 30 years who after 6 months of urinary distress had his right kidney removed for unilateral renal tuberculosis. He also had a chronic pulmonary lesion. His wound reopened after healing but 1 year later his urological follow up showed a perfect result. Two years after operation he was readmitted on account of marked weakness and pigmentary changes typical of Addison's disease. He had no urological complaints. Five weeks after admission he died. Autopsy showed tuberculosis of the peritoneum, lungs, and the adrenal gland. The remaining kidney was normal.

The records of the 3 patients known to have died outside of the hospital, show the following:

One was a man of 27 years, whose removed kidney showed fatty degeneration and diffuse calcification. He also had tuberculosis of the left lung with partial collapse. His bladder symptoms which had existed 1 year prior to operation were not relieved and he died 3½ months later in a sanitarium.

The second case was a girl of 23 years with bilateral renal tuberculosis. She also had a diffuse left lumbar abscess and a urinary fistula which developed 1½

years before we saw her following an attack of urinary retention. A left nephrectomy and drainage of the lumbar abscess were done as a palliative measure. The kidney showed an acute tuberculous hemorrhagic nephritis. She lived 6 months only. Toward the end she had a severe bloody diarrhea so that in addition to her known renal poas, and lumbar involvement, the gastro-intestinal tract was probably diseased as well.

The last patient was an Italian male of 34 years who had his right kidney removed for supposed unilateral tuberculosis. He also had pulmonary tuberculosis and tuberculosis of the epididymis with a fistula. He did not improve and 6 months later his bladder urine showed tuberculosis. Fifteen months after operation he died. Postmortem examination showed tuberculosis of the lungs, the peritoneum and the remaining kidney.

All of the patients who died were in their twenties or early thirties except one man of 50 years who died of pneumonia. As to the bilateral cases in these reported deaths, it is easy in retrospect to criticize one's having subjected these patients to nephrectomy, but under the circumstances it seemed to be the right thing to do. Also, in going over the record of the bilateral cases still alive following the removal of the more diseased kidney, there is some very encouraging reading.

**Follow-up reports.** In 9 cases we have been unable to obtain any record after operation despite earnest efforts of our social service department both by letter and personal investigation. This may be due in some part to the transient nature of the New York City population. We have follow up records on 75 cases 73 of which were supposed to have had unilateral lesions only. These reports are arbitrarily rated by the same method long in use in other departments in the hospital. The anatomical, symptomatic and economic results are each graded from 1 to 4, 4 being perfect. For instance, 4 4 4 means that the wound is well healed, there are no symptoms and the individual is able to do a full time job. An attempt is made to follow these cases for at least 5 years of course in this present list only those from the earlier years of this series are available for a report of that duration.

The 3 bilateral cases who were subjected to nephrectomy of the more diseased kidney are alive 3, 3, and 1 years after operation. One apparently enjoys good health, 1 is working in Colorado although he has bladder com-

plaints of moderate severity, we rate him 4 2 4. The third has his wound still draining, his symptoms persist, and he cannot work. His rating is 0 2 0.

Of the 73 unilateral cases available for follow-up study, at the end of 1 year 16 were graded 4 4 4, 4 were graded 4 3 4, 6 were graded 4 2 4, 5 were graded 0 3 4. In these last 5 the wound had not entirely healed in 4 and 1 had an incisional hernia. Two were graded 4 2 0.

After 2 years, 12 more cases were graduated to the 4 4 4 class making 28 in all. This cured rating progressively increased each year so that as of today the last records on these 75 patients, varying from 1 to 7 years after operation show 32 cases in the 4 4 4 class. This rise from 16 the first year and 28 the second year was due to our tracing patients who had not responded to our previous efforts. Also, many of these were private patients and, until this study began, the follow up data had not been elicited from their doctor's private files or the hospital record. There were 6 patients who for the first year or two improved slowly or at all, but later had a good result. One man showed no improvement in symptoms at first, and 2½ years after operation his bladder showed tubercle bacilli. Four years after operation he was perfectly well, the urine was negative and he was working at a good job. Five years after operation he was still in good health but he had a tuberculous epididymis with nodule formation. One woman had little improvement in bladder symptoms until 4 years after operation, since which time she has been free from urinary trouble. In 2 patients it was over a year before their wounds healed. Two were thought to be probably bilateral cases up until 2 years after operation, yet all of these 6 were later in the 4 4 4 class.

Histories like these give real hope where slow postoperative progress would seem to indicate a bad prognosis. In no instance has a 4 4 4 rating had to be changed later.

Another group of 8 patients after 2 years or more were listed as 4 3 4 or 4 2 4 meaning their wounds were firmly healed and they were working, but they still had urinary frequency. The urine was clear in 4 of them, and in 4 it was cloudy. There was a definite contraction of the bladder of varying degrees in all.

*Inoperative cases* In this 7 year period there were 14 bilateral cases in which patients were not operated upon. Of the 14 only 3 were without tuberculosis elsewhere, 4 were with-

#### EVALUATION

Fifty-two excellent results in 73 available in this study of 66 nephrectomies is by no means discouraging. The 11 deaths do not seem out of proportion to the problems presented. There were only 4 so called "operative" deaths. In several bilateral cases patients were operated upon for palliative reasons only. Apparently the existence of tuberculosis elsewhere in the body, the length of time it takes the operative wound to heal, the history of hematuria or the duration of the symptoms before operation, have little prognostic value as to the eventual urological result. While the relief of frequency after operation is encouraging, the persistence of some does not necessarily mean a bad outlook. Some of these patients will maintain perfect health except for the frequency of urination due to a contracted bladder. A few patients may show tubercle bacilli in the bladder urine for as long as 2 years and yet retain good health with relatively normal bladder function. It may well be that when one renal lesion is apparently causing the majority of urinary symptoms, that kidney should be removed if the other kidney is functionally normal, even if the pyelogram is suggestive of tuberculosis, it is the patient's only chance for relief and possibly cure.

Several cases in this series were of particular interest, because a bad prognosis at the time of operation proved wrong in the light of reports several years later. Our general impression as to the outlook for a patient afflicted with renal tuberculosis is more optimistic than it was before this study. This is true for patients where extrarenal disease was shown to be present as well as for those in whom the kidney lesion only could be demonstrated.

Renal tuberculosis must be considered as only part of a generalized tuberculosis or a tendency toward it. Where economic conditions permit, every effort should be made to have the patient guard himself from further manifestations of the disease by the best pos-

In 7 patients our last record was only 1 year after operation, and is consequently of not much value. Four were graded 4 2 4, three 4 3 4, and one 0 2 4 at the end of the year.

Another group of 5 are rated as bad results. There was no improvement in urinary symptoms in any one. Two young men 2 years after operation, in addition to their continued bladder distress had active pulmonary tuberculosis, and 1 had tuberculosis of the epididymis. In the case of 1 woman 5 years after operation, while her general health had not failed, tubercle bacilli were found in her remaining kidney. Another woman of 50 was found to have the remaining kidney infected 2 years after operation, and there were tubercles in the bladder wall. She also had tuberculosis of the breast and sternum. One man of 50 was bedridden for nearly a year after operation without any improvement of symptoms, and his wound was still open. He was transferred to a state hospital.

There were 3 patients who before operation were thought to have renal tuberculosis, but the pathological examinations could not confirm this diagnosis. In 1, the diagnosis was made on account of hematuria and frequency and the finding of a decreased bladder capacity, ulceration seen near the right ureteral orifice, and a junctionless right kidney. The kidney showed only chronic nephritis. In the second case, the right kidney specimen showed pus cells, and tubercle bacilli were reported as being found. The pathological diagnosis was acute pyelonephritis with no evidence of tuberculous. In the third case, a 24 hour specimen was reported positive once, and a pyelogram showed some hydropneumothorax of the right kidney. No tubercle bacilli were found in the kidney specimen. Pathological diagnosis was acute nephritis, hydropneumothorax, and questionable tuberculosis. Fortunately all 3 have today a 4 4 4 follow-up status. To sum up the known cases of renal tuberculosis who were thought to have unilateral lesions at the time of operation, we have information on 73 at intervals of 1 to 7 years after nephrectomy—52 are in the 4 4 4 class, 8 are in the 4 2 4 or 4 3 4 class after 2 years, 7 rate 4 2 4 or 4 3 4 after 1 year, 5 cases show very bad results, 1 man is well but has hernia of his operative wound.

sible anti tuberculosis mode of living. Insistence upon this point seems to be the only way by which we can make future follow up reports improve upon those of today.

As an example I wish to present the case of a young man whom we saw several years before this series of cases began.

He had a draining suprapubic sinus following an ill advised cystostomy done elsewhere 1 year before we saw him. We found one kidney to be tuberculous and removed it. Later the suprapubic sinus tract was excised and successfully closed, after which he voided for the first time since his first operation. We sent him to the country and did not see him until a year later when he looked well and had gained 30 pounds. His only urinary symptom was slight frequency. Despite our advice he returned to New York City to the same work and living conditions which may have caused his original infection. Within 6 months his urinary symptoms increased, his prostate and both epididymides became involved, a rectal fistula developed and he lost much weight. A roentgenogram of his chest showed a miliary tuberculosis and he soon died. This tragic ending might have been avoided had this patient remained in the country where he was doing so well.

I dwell on this case because it vividly exemplifies two important points: (1) the removal of a tuberculous kidney even where it effects an apparent complete cure is not the only step needed in this disease. (2) The correct after-care must be more seriously stressed if we are to improve our results. Of course in many cases the economic conditions do not permit postoperative care, in others however without being unduly dramatic the doctor can present the risks squarely and insist upon a different basis of life if the patient is interested in living at all. With the co-operation of an efficient social service which we are fortunate enough to have apparently impossible situations can often be satisfactorily solved.

#### SUMMARY

A 7 year study of renal tuberculosis in the Squier Urological Clinic is presented.

Special attention is given to death analyses and follow-up reports. The importance of postoperative care is emphasized.

# CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF CALIFORNIA

## RECONSTRUCTION OF THE BILE DUCTS

### New Method of Anastomosis

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**STRUCTURES** of the common and hepatic ducts, though not unheard of, were of little importance until after our surgical procedure changed from cholecystostomy to cholecystectomy. This more radical procedure involved the exposure of the cystic, and usually of the common, duct and frequently the opening and probing of these ducts for the presence of stones. In the past few years, certain writers (10) have advocated the routine opening and exploration of the common and hepatic ducts when stones were found in the gall bladder, or even in the presence of inflammatory conditions (1). Others (6) have insisted upon the ligation of the cystic duct at, or very near, its union with the common duct to prevent the reformation of gall stones in this stump (2).

When we take into consideration the fact that anomalies of these ducts and of the blood vessels accompanying them are present in from 20 to 30 per cent of all persons (13), it would seem inevitable that these attempted refinements of technique should be accompanied by a certain percentage of accidental injuries. Such injuries range from direct ligation and division of the ducts to those resulting from hemorrhage followed by cicatricial reaction and stricture. Even if the original injury is recognized and repaired immediately, stricture is not entirely avoided. Those injuries that are unrecognized tend to swell the number of unassociated procedures a certain percentage of them occur so long after operation that it is hard to understand how the surgical procedure could be responsible. It is probable that these late strictures are the result of cholangitis and are similar to those described as having occurred in persons in whom no surgery has been done (8). While certain clinics (10) report no increase in mortality or in the number of complications when

the common duct is opened routinely, it seems improbable that this record can be equalled in operations on the biliary tract done by surgeons in general, and it would appear that a widespread attempt to follow the lead of these clinics must bring about an increase in the number of complications.

The whole subject of biliary obstruction has been so thoroughly considered by various authors (5, 7, 8, and 15) that little additional remains to be said, even with the added experience of recent years. In this brief discussion only cases of the benign stricture, occurring after removal of the gall bladder, will be considered. Among the procedures which have been tried for the relief of such strictures are

- 1 Plastic operations on the common duct itself
- 2 Division of the strictured area of the common duct with end to end anastomosis, or anastomosis of the proximal end to the duodenum or other portions of the intestine
- 3 Anastomosis of the distended common or hepatic duct, without excision, to the (a) duodenum, (b) stomach, (c) jejunum or ileum,
- (d) colon
- 4 Transplantation to the intestine of fistulous tracts

Plastic operations on the ducts are not often possible from a technical standpoint, when done they seldom achieve satisfactory results because of recurrent obstruction. Most of the plastic surgery attempted has followed the principle of the Heineke-Mikulicz or Horsley operation on the duodenum.

The last method, like the first, has a limited field of usefulness. It involves the use of a fistulous tract, the result of long continued drainage from the bile ducts through the abdominal wall. This tubular tract, lined with epithelium, has been dissected out and transplanted into the duodenum or stomach. At least a dozen such successes

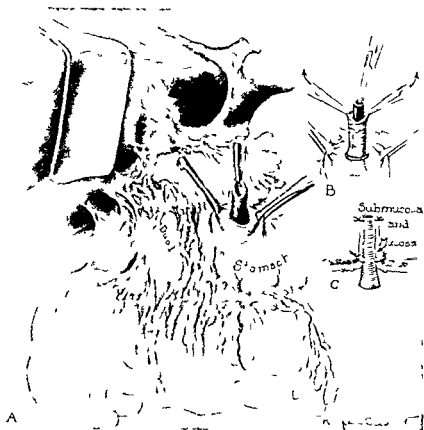
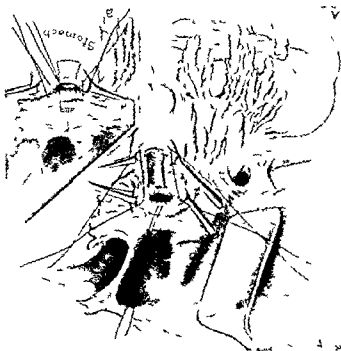


Fig 1

ful transplantations have been reported (14). There have been, however, more failures than successful results from this procedure and it has been no more satisfactory than plastic operations on the common duct itself. It should be employed only when other types of anastomosis cannot be done.

The greater number of plastic repairs reported have been accomplished by means of an anastomosis of the common duct to the duodenum. The early work on this subject particularly that of Mayo, beginning as early as 1905, assumed that anastomosis to the duodenum was essential to good function, as the natural communication is into this part of the gut. For this reason the greatest number of anastomoses since that time have been to the duodenum. These operations have usually been attended by a high percentage of excellent results. Many authors believe, however, that there is less ascending infection and reaction when the anastomosis is made to the stomach than when it is made to the duodenum and others feel that the results of this procedure are at least equally good.

The experimental work of Oddi and Dostre, more recently confirmed by Beaver and others who have studied the effect of shunting the contents of the biliary tract into the stomach, showed definitely that bile has no effect on the motility, acidity, or emptying time of this organ. These facts have been commented on by various authors, but need to be emphasized again. Almost without exception, however, whether the anastomosis is made to the stomach, duodenum or other part of the intestine, transient attacks of chills, fever, and jaundice follow (14). Such reactions come from two sources: first, a latent infection which remains in the ducts; second, an ascending infection from the gut which produces a similar chain of events—namely, chills, fever, and jaundice. This reaction is of about the same degree whether the anastomosis is made to the stomach or to the duodenum. If, however, the anastomosis is made farther down the intestinal tract the infection is more serious. Apparently the sphincter of Oddi has a function—the prevention of ascending infections—which we are unable to duplicate surgically.



or removed by suction. A pursestring suture of catgut is laid around the edge of this opening, going in and out.

Step III. Loose catgut sutures, usually three or more in number, attaching the wall of the stomach to the bile ducts or surrounding adhesions, are laid down and clamped (Fig. 2, A).

Step IV. The tube, covered with mucous membrane, projecting from the stomach, is thrust into the opening of the bile duct, the posterior approximating sutures are drawn taut and tied, the pursestring suture surrounding the opening in the bile duct is drawn taut and tied around the tube, and the upper approximating sutures, previously laid down, are tied (Fig. 2, B).

The result of this procedure is a tube, covered with the mucous membrane from the stomach projecting well into the bile duct, with mucous membrane approximated to mucous membrane, and with the peritoneum of the stomach well approximated to the peritoneum of the bile duct. The operation can be done rapidly, with a minimum of technical difficulty, and in my experience has been very satisfactory. I do not know how long this tube remains in place—probably only for a few weeks.

# REPORT OF CASE OF ANASTOMOSIS OF HEPATIC DUCT TO STOMACH

Mrs W. A. S., 55 years of age, a housewife began to have attacks of gall bladder disease many years ago. A diagnosis of gall stones was made 8 years before operation was performed. On January 6, 1930 the gall bladder was removed elsewhere. Considerable hemorrhage was also

Since the stomach tolerates the presence of bile as well as does the duodenum, the choice of procedures should depend upon the technical difficulties involved. While the establishment of drainage to the duodenum has been the procedure of choice, if mechanical difficulties are present—particularly the necessity for extensive dissections, the breaking up of adhesions, a lack of natural approximation or other causes—union to the stomach is just as satisfactory and often can be more easily and quickly done. In addition to the simplicity of this procedure, it is well known that the content of the stomach, if leakage should occur, has less digestive action upon the skin and other tissues than the content of the duodenum. Any leakage from the duodenum may be a serious or fatal complication. Often the duodenum is thin and friable while the wall of the stomach is thick, holds sutures better, and insures a better union.

**TECHNIQUE OF OPERATION!**

Step I. A small opening is made in that portion of the stomach which best approximates the dilated bile duct. The edges of the mucous membrane are grasped with Allis forceps and drawn out through the opening in the musculature (Fig. 1, A). This loose mucous membrane can be withdrawn from 1 to 2½ centimeters beyond the muscular wall. A rubber tube is inserted through this opening in the stomach and the edges of the mucous membrane are sutured to the outer end of the tube, with the mucous membrane covering it, is then pulled out as far as possible without causing undue tension and then the muscular coat of the stomach is sutured to the base of the tube to maintain the projection (Fig. 1, B and C).

Step II. A small opening is then made in the distended bile duct and the contents are aspirated

Additional items of technique which have been found useful (1): The rubber tube should not be larger than a hard rubber blade No. 10 will make. (2) The flared end of a catheter No. 12 or 14 is frequently a better tube for an anastomosis. (3) It is frequently advisable to allow the rubber tube to project about 1 centimeter beyond the free edge of the mucosa to facilitate handling without tearing it. (4) A continuous line of peritoneal sutures may be used if the tension of the bile or surrounding adhesions are strong and thick enough to give a good union. (5) The same technique is entirely satisfactory in doing a choledochostomy.

ciated with the operation. Hernia developed and was repaired in April 1935 without success. In the latter part of July 1935 the patient began to have pain in the abdomen and jaundice appeared rather suddenly. The jaundice increased and obstruction of the common duct soon became complete. The obstruction had existed about 7 weeks when the patient was referred to me.

When I saw her on August 9, 1935 the patient had a total obstruction of the common duct, was losing weight at the rate of 1 pound a day and weighed only 90 pounds. Her condition was desperate.

**Operation.** The abdomen was opened through the old scar. The omentum and transverse colon were found densely adherent to the liver. As these adhesions were dissected off the left hepatic duct came to view. It was very large and dilated and the wall was very thin. In dissecting the adhesions from this dilated duct it spontaneously ruptured and about 400 cubic centimeters of white bile exuded. The common duct could not be identified; it was buried in a mass of adhesions which apparently totally obliterated it. The duodenum was also markedly adherent and was recognized with difficulty. The dilated left hepatic duct lay directly over the pyloric end of the stomach. An anastomosis was made between them by the technique described above. It seemed necessary to repair the hernia because protrusion of the viscera might allow tension upon the anastomosis. This was done by the massive overlap method with interlocking rows of mattress sutures. The patient's recovery was uneventful. The rubber tube was seen in the small intestine 4 weeks after the operation and was passed soon after.

During the first year after operation this patient had 3 attacks of chills, fever and jaundice, the longest of which lasted 2 weeks. Since that time there have been slight attacks of indigestion from time to time but no other untoward symptoms. The patient is well now 6 years after operation.

#### SUMMARY

1. Anastomosis of any part of the occluded bile duct to the stomach gives just as satisfactory function as does anastomosis to the duodenum and frequently can be more easily and safely done.

2. A new rapid method of anastomosis of bile duct to the stomach is demonstrated which ap-

pears to have certain advantages over the direct suture method.

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# HEMITHYROIDECTOMY IN STAGES IN THE TREATMENT OF HYPERTHYROIDISM

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THE employment of stage operations in the severe grades of hyperthyroidism has long been recognized as a valuable method of reducing surgical mortality. Ligation of the superior thyroid vessels is a distinctly useful operative procedure in the surgical management of a small percentage of toxic goiter patients and is still of great value as a preliminary measure in patients with hyperthyroidism who are too ill for even a right hemithyroidectomy. Lahey and Schwalm have recently published a review of a series of 119 patients who had pole ligations performed in this clinic, and their study reveals that approximately 65 per cent of these cases showed improvement in their disease as indicated by a gain in weight, decrease in basal metabolism, and a drop in pulse rate. In other words, a definite marked improvement was noted in a large percentage of these seriously toxic cases, following which a right subtotal hemithyroidectomy could safely be performed. We have thought that it might be of value to carry out a similar study of a group of cases requiring a two stage operative procedure and recording the results obtained following a right subtotal hemithyroidectomy. For this review we have selected a group of 250 consecutive cases of hyperthyroidism, upon whom a two stage right and left hemithyroidectomy was done at intervals of 6 weeks. In this group of 250 cases, there were 149 cases of primary hyperthyroidism and 101 cases of secondary hyperthyroidism occurring in adenomatous goiter, and of this series there were 48 men and 202 women, which is approximately the ratio of hyperthyroidism noted in the two sexes (1:4).

In addition to reporting some of the results obtained by a two stage procedure, we wish to discuss some of the indications for such conservative surgery and also to point out a few of the factors influencing the operative mortality rate. Through the use of iodine and by continuing to employ stage procedure, we have today changed the uncertainty of thyroid surgery to an operative procedure with a large margin of safety. It is difficult to estimate precisely the influence of such factors as age, duration of disease, the severity of hyperthyroidism as evidenced by high basal rate and other more indefinite factors, such as debility and degenerative changes, but experience has

taught us that such factors as these must make us in many instances, at least, consider conservative surgery if we hope to avoid an operative fatality.

Any clinic possessing a reputation for handling a large number of thyroid cases will necessarily attract a great many serious goiter patients. A large majority of these patients will represent very definite increased operative risks by virtue of their thyroid intoxication, and while many of these patients present problems pertaining only to a severe grade of hyperthyroidism, other patients will fall into this high risk group because of the additional technical difficulties encountered at operation in such patients. We refer specifically to the group of large intrathoracic goiters with hyperthyroidism exhibiting evidence of tracheal compression or deviation. Because of this reputation of a large experience in thyroid surgery, the surgeon's obligation to these patients is increased manifold.

In order to manage this group of increased risks we must outline definite criteria which will enable us to estimate more correctly the operative hazard and to predict more accurately a safe outcome. Much more important than the mere recognition of the increased risk, we must plan a type of procedure that we know, from experience, will most certainly increase the patient's chances of surviving the operation. The demand in these bad risks is for a safe operative procedure. It is our plain duty to patients in this high risk group to meet this obligation, and this is best met by conservative operative measures. It is true that the introduction of iodine by Plummer has had a far reaching effect upon the treatment of diseases of the thyroid gland and the contrast between the present treatment and that before iodine was employed is tremendous. Where in the past numerous articles emphasized the necessity of stage operations to prevent fatalities, more recent papers have called attention to the pronounced effect obtained by the administration of iodine upon the course of the disease and upon the pathological changes in the thyroid gland. Recently the impression has grown widespread that stage operations are no longer needed in the treatment of severe hyperthyroidism and that if the patient is prepared properly before operation, if the operation is performed without technical mishaps and within a reasonable time, the patient will easily

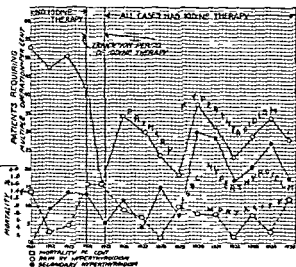


Fig 1 The percentage of cases of primary and secondary hyperthyroidism requiring two or more operations. For the last 6 years the two curves exactly parallel each other and more nearly approach. Note change in number of multiple operations with use of iodine after 1925. The mortality rate is also recorded. Note that in most instances the mortality rate rises with decrease in the number of multiple operations as in 1925, 1929 and 1935, whereas in 1906, 1930 and 1934 the mortality rate decreases with more stage operations.

withstand a complete subtotal thyroidectomy. Based upon our experience nothing is farther from the truth and if this opinion is persisted in it will undoubtedly result in many unnecessary operative deaths.



Fig 3 A case of apathetic hyperthyroidism. Note the wrinkled skin, the extreme weight loss, the lack of eye signs, lack of activation, lack of thyroid enlargement, and the suggestion of apathy. Note also the senile appearance although this patient was 40 years of age. Basal metabolic rate was +21, pulse 104. A two stage operation was done with a weight gain of 8 pounds in 6 weeks between stages. Excellent recovery.



Fig 2 Severe primary hyperthyroidism—basal metabolic rate +3, pulse 76 upon admission to hospital. 44 years of age with loss of 36 pounds over a period of 2 years. Note marked exophthalmos. Photograph made 5 days following right hemithyroidectomy, first stage. Course during operation confirmed clinical impression of intense degree of toxicity.

Prior to the development of the use of iodine in the preparation of toxic thyroid patients for surgery, stage operations were performed in many instances in the more intensely toxic cases. A large majority of these patients required two or more stages, and we have all had the experience of doing as many as five or six stages in the more



Fig 4. A left, Severe primary hyperthyroidism in child of 10, note stare, enlarged thyroid, evidence of weight loss. Basal metabolic rate was +68, pulse 100. B, same child 6 weeks after right hemithyroidectomy and 3 days after left hemithyroidectomy, second stage. Note absence of stare, gain in weight of 20 pounds. Pulse was 85, basal metabolic rate +3 at time of second admission to hospital. Marked improvement in 6 weeks.

TABLE I—STAGES NECESSARY—1921 TO 1924

	2 stages per cent	3 stages per cent	4 stages per cent	5 stages per cent	6 stages per cent
1921	35	13.5	3.4	0	0
1922	27	14.3	5.5	0.8	0
1923	34	10.6	4.7	0.6	0.6
1924	30	11.7	4.0	1.3	0

when a patient dies following a subtotal thyroidectomy that patient would probably have survived if a right hemithyroidectomy had been done, that if death ensues after a right hemithyroidectomy, a bilateral superior pole ligation should have been done as a preliminary measure. That a low mortality rate can be obtained by that frequently one can operate upon a large conservative measures is illustrated by the fact that a low mortality rate can be obtained by that frequently one can operate upon a large group of cases without a single fatality, in 1922 we performed 101 consecutive thyroid operations with but 1 death. In this clinic we have now (October 1, 1936) performed 15,214 thyroid operations with 111 postoperative deaths, a mortality rate for the series of 0.73 per cent. All deaths occurring from emboli, cardiac failure, pulmonary complications and from operations for cancer of the thyroid are included in this group. During this same period there were 60 deaths in patients so seriously ill with hyperthyroidism when entering the hospital that we were unable to prepare and bring them to operation although every known measure to combat thyroid crisis was employed. In spite of the great benefit derived from employing iodine in the pre operative management of patients with hyperthyroidism, we are continuing to use stage operations in a considerable percentage of our toxic patients and in our hands the utilization of stage procedures has been one of the most valuable means of preventing operative fatalities. As stated above, there has been a marked decrease in the number of pole ligations done since iodine has been in use. Over a period of 10 years, from 1926 through 1935, we have done preliminary superior pole ligations in 12 per cent of our cases of hyperthyroidism. During 1924 we performed 57 pole ligations, whereas in the 11 years following only 67 ligations were done. A somewhat similar decrease has been noted in the number of patients requiring multiple stage operations, as in 1921, one of the pre iodine years, 47 per cent of all the cases of hyperthyroidism required multiple operations, whereas in 1929, with the employment of iodine in preparation for operation, only 16 per cent had operations in stages. The percentage of patients requiring stage procedures has, of course, varied

seriously ill, hyperthyroid individual. From January, 1925, to the present time all patients with hyperthyroidism in this clinic have received iodine in preparation for surgery, and it is of interest to note that over a period of 11 years, from January, 1925, to January, 1936, no toxic thyroid patient has required more than five operations—that is, a preliminary bilateral pole ligation followed by a right and left hemithyroidectomy at intervals of 6 weeks. Prior to this period in many cases four and five stage operations and occasionally six operations were necessary to prevent operative fatalities and safely to terminate the disease. Table I illustrates the number of stage procedures performed over a period of 4 years from 1921 to 1924 before iodine was used and shows the relatively large number of cases in which three or more stages were necessary. Prior to this period the surgeon feared the development of serious postoperative reactions. These reactions were very frequent, were often difficult to handle and not uncommonly resulted in a fatality, consequently, during this period conservative surgery was quite universally adopted and practiced in clinics having a considerable experience with thyroid diseases. The employment of iodine before operation has resulted in great improvement in the handling of these cases and has been extremely valuable as a means of treatment following operation. The period of pre operative management has been decreased, the technical difficulties previously noted during operation have been lessened, because of earlier and more complete involution of the gland, and a smoother convalescence has resulted. We have noted, moreover, a decrease in the number of preliminary pole ligations and of stage operations and, finally, a decrease in the operative mortality. While we believe that the employment of iodine has accomplished a material advance in the treatment of hyperthyroidism, we still feel, nevertheless, that there is a very definite need for stage procedures in the intensely intoxicated thyroid patient if we are to keep the mortality rate at a minimum. It has been our experience, and we are firmly convinced from a study of our large series of thyroid operations, that the operative mortality rate in this high risk group is definitely proportional to the number of stage operative procedures performed. It has also been our experience that while there has been a material decrease in the number of patients requiring stage operations, we have noted a greater decrease in the number of operations required per person. Dr. F. H. Lahey has repeatedly emphasized that

TABLE II — HYPERTHYROIDISM REQUIRING MULTIPLE STAGE OPERATIONS

Type of hyperthyroidism	Multiple operations per cent	Operative mortality per cent
Primary	28.9	0.48
Secondary	17.8	1.55

from year to year, yet there has regularly been a quite definite decrease. Over a period of 10 years from January, 1926, to January, 1936, 28.9 per cent of our cases of primary hyperthyroidism had stage operations with an operative mortality of 0.48 per cent.

During this same period 17.8 per cent of our adenomatous goiters with secondary hyperthyroidism were operated upon in multiple stages with an operative mortality of 1.55 per cent. Table II illustrates the percentage of cases of primary and secondary hyperthyroidism requiring multiple stage operations over a period from 1921 to January 1936. It will be of interest to note that less stage procedures were performed upon adenomatous goiter than upon primary hyperthyroidism, yet secondary hyperthyroidism in adenomatous goiter carries with it a greater operative hazard. The mortality rate for adenomatous goiter with secondary hyperthyroidism has always been higher than the rate for primary hyperthyroidism and for the period here recorded it has been three times as high.

Next to the employment of stage procedures in reducing operative mortality has been the development of an organization of co-operative management of patients with hyperthyroidism whereby during their entire period of hospitalization they are under the constant supervision of both the surgeon and the internist. This medical and surgical integration makes for a more accurate estimation of the operative risk, a more efficient preparation of the patient for surgery, postoperative complications can be handled more intelligently, and certainly the complications can be recognized earlier and adequate treatment instituted sooner. Dr. Lahey repeatedly has emphasized the serious emergency situations which will occasionally arise following thyroid surgery, and every member of the staff, whether surgical or medical, must be aware of the possible character of these mishaps and be prepared to anticipate or meet them should they arise.

As a measure of general precaution, every patient with thyroid disease examined in this clinic has an estimate of the operative risk made by each examiner. We have made use of a more or less arbitrary scale by which we have indicated the

risk as follows: Grade I being a good risk, grade II, a doubtful risk, grade III, a dangerous risk, grade IV, a risk in which a fatality will almost certainly result if operation is performed. In addition, after a few days' preparation in the hospital, we ask each examiner to estimate the extent of the operative procedure that the patient can probably withstand without a fatality ensuing and to record such an opinion on the patient's record. It is our custom to utilize constantly the experience and advice of our anesthetists. The anesthetist will, in every instance, see each patient the day before the patient comes to the operating room. He will examine the patient and review the case record and will in every instance record his opinion of the operative risk. If the surgeon ignores the warnings, if so recorded, and does not choose a conservative procedure and a fatality occurs, the responsibility is so plainly his that he will probably never do it again. Probably a few more stage operations than are necessary will be done by this plan, but this, we feel, will be but a minor consideration if but a single life be saved. We have always taken the consistent stand that if there is any question of doubt as to the amount of surgery that a patient can withstand, we must by all means choose the more conservative measure. No excuse can be acceptable in the face of such warnings if a fatality results. We must not adopt a complacent and fatalistic attitude toward any such death. Experience it is true can and does provide the background by which deaths may be avoided, but death, in spite of experience, must not be the excuse with which casually to explain an unexpected death. We must profit by the lesson which a critical review of the case history of every thyroid death brings to us and too frequently we must frankly admit that no explanation is forthcoming other than that too much surgery has been done and bad judgment employed.

It is obvious that the determination of the operability of patients with severe hyperthyroidism is to a great degree dependent upon a large experience with thyroid surgery, but it is also to a considerable extent dependent upon other factors, such as age, duration of disease, severity of the intoxication, weight loss, and such factors. While it may be true that we cannot sharply separate by age, by height of basal metabolism, by weight loss, etc., the severe cases which require stage procedures from the less toxic cases which will not, yet we know from long observation that a careful evaluation of all these combined factors will usually indicate that the hyperthyroidism is of such a degree of severity

TABLE IV.—DURATION OF DISEASE—  
250 CASES—TWO STAGES

Total per cent	Cases of secondary hyperthyroidism	Cases of primary hyperthyroidism	Duration		
			1 to 6 months	7 to 12 months	13 to 5 years plus
22.8	22	35	34	56	5 years plus
20.0	16			20	2 to 5 years
37.6	38			13	1 to 2 years
12.8				13	
6.8				4	
100.0	101	149			

TABLE III.—AGE INCIDENCE—250 CASES  
WITH OPERATION IN TWO STAGES

Between ages 3 years	Cases of primary hyperthyroidism	Cases of secondary hyperthyroidism	Total				
			10-20	21-30	31-40	41-50	51-60
7.4	5	1	0	5	10	19	29.6
5.2	13	0	0	0	10	45	41-50
21-30							
31-40							
41-50							
51-60							
61 and over							
21.2							
100.0	101	149					

Youngest patient with primary hyperthyroidism 7 years oldest 72 years  
Youngest patient with secondary hyperthyroidism 12 years oldest 98 years

that a fatality will almost certainly result if a complete subtotal thyroidectomy be done. The age of the patient has always been of value in estimating the operative hazard in any type of surgery and this is particularly true in surgery of the thyroid gland. Elderly patients are considered to be poor operative risks, and, when severe thyroid intoxication is present in this older group, our choice of stage procedures must be frequently influenced by this fact. The so called reserve of a younger individual has definitely decreased in patients past middle age and the capacity to withstand the added insult of operative hazard is much lessened. In people of advanced years we are dealing with a high risk group, and the possibility of two or more stage operative procedures must be considered in this group. It is of interest to note that of 93 deaths of the total of 111 postoperative thyroid deaths in the history of the clinic, there were 73 patients who were 41 years of age or over. It is also noted in the group of 250 cases of hyperthyroidism in this series that 76 per cent were 41 years of age or over (Table III). We have also called attention to the fact that patients with secondary hyperthyroidism are usually older than those with primary hyperthyroidism. In this series, 38 per cent of the patients with primary hyperthyroidism are over 51 years of age, whereas 70 per cent with secondary hyperthyroidism are 51 years or older.

The duration of the hyperthyroidism undoubtedly has had a definite influence upon the mortality rate. It has been our experience that patients who have had the disease for a period of a year or more have a higher mortality rate than those ill for less than a year. Approximately 85 per cent of the 93 deaths referred to had had hyperthyroidism for a year or more. One cannot overstate the conviction that long continued thyroid intoxication produces undesirable changes in the body. In the earlier stages of the disease we have to deal only with the severity of the hyperthyroidism, whereas later we have, in addition, to cope with these organic changes. We know that in patients with prolonged and severe hyperthyroidism liver function is materially interfered with and it is not at all uncommon even to see jaundice in the severely intoxicated thyroid patient. Major cardiac disability is frequently encountered as a result of an overactive, irregular heart and increased circulatory demands upon the heart over long periods of time (Table IV). In the patients studied in this series, 143, or 57 per cent, had the disease over a year, whereas 77 per cent had the disease over 6 months. There is no doubt that the longer patients have had hyperthyroidism, the more serious is the operative hazard, and it is in this group that we must frequently choose the more conservative procedures if we wish to avoid operative deaths.

Weight loss, which may even be excessive, is a common finding in patients with severe hyperthyroidism. We have seen tremendous emaciation and debilitation resulting from an intense degree of toxicity and we have seen these patients lose weight in spite of an intake of food far beyond their normal need and capacity. Due to this intense intoxication resulting from an abnormally overactive thyroid, there is an actual consumption of the patient's tissues not compensated for even by a vastly increased food intake. These patients will frequently progress into a state of thyroid crisis if the process is allowed to continue unaccompanied, and many of the patients in this group must be candidates for stage operations if we are to avoid operative fatalities (Table V). We regard marked weight loss to be a definite indication of operative hazard and in this series

TABLE V—WEIGHT LOSS PRIOR TO ADMISSION TO HOSPITAL—250 CASES—TWO STAGES

Pounds	Cases of primary hyperthyroidism	Cases of secondary hyperthyroidism	Total per cent
Indefinite	13	10	13.3
1 to 10	24	10	13.6
11 to 20	37	20	22.8
21 to 30	47	15	18.0
31 to 40	23	14	14.8
41 to 50	10	8	7.2
51 plus	15	11	10.4
	149	101	100.0

Greatest weight loss—84 pounds.

we find that 73 per cent have lost 10 pounds or more and that 10 per cent have lost 50 pounds or more. Frequently we see patients who have lost more weight than their actual body weight recorded upon admission to the hospital. The greatest weight loss in this group was 84 pounds.

Basal metabolic rates when high, are approximate measures of the intensity of the toxic process but are not reliable indices for estimating the degrees of operative risk. While a high rate usually accompanies severe hyperthyroidism, a low rate does not necessarily mean a milder degree of toxicity and certainly is no indication of the patient's ability to withstand the intoxication or operation. Of the 250 patients in this series, there were 38 patients whose initial basal metabolic rate was plus 50 or less and yet, because of other symptoms noted we regarded these cases to be in such a high risk group that we considered that they should have a two stage procedure. We have all seen patients with a normal or relatively low basal metabolic rate who may even have a pulse rate of 80 to 90 and yet who are markedly activated, whose hands are hot and moist, and who have lost great amounts of weight (Fig. 2). We must measure the degree of intoxication by many factors and one's judgment as to the degree of risk is often substantiated by the patient's course while undergoing the operation. Basal metabolic rates are ordinarily higher in primary, than in secondary, hyperthyroidism and in this group 60 per cent of those with primary hyperthyroidism had a metabolism above plus 50, whereas only 33 per cent of the toxic adenomas had a metabolism of plus 50 or above (Table VI).

Three patients were noted with basal metabolic rates of plus 110, plus 119, and plus 123, respectively, and these were cases of primary hyperthyroidism.

TABLE VI—BASAL METABOLIC RATE—250 CASES—TWO STAGES

Metabolic rate	Cases of primary hyperthyroidism	Cases of secondary hyperthyroidism	Total per cent
Not recorded	0	1	0.4
Plus 10 to plus 30	16	22	15.3
Plus 30 to plus 50	44	45	35.6
Plus 50 to plus 70	60	24	32.6
70 plus	29	9	15.1
	149	101	100.0

Thyrocardiacs present an increased operative hazard whenever subjected to an operation. In this clinic the term thyrocardiac has been employed to describe patients with hyperthyroidism in whom major cardiac disability has been a prominent feature. Dr. L. M. Hurxthal of the medical department of the clinic, in studies of this group has found that in approximately 10 per cent of all toxic thyroid cases auricular fibrillation is present, either transient or established, and that in 4 per cent congestive heart failure is noted. In this series of 250 cases, 35 per cent of the patients had evidence of cardiac disability such as auricular fibrillation, gallop rhythm, congestive heart failure, or other cardiac disability. In 55, or 22 per cent, auricular fibrillation was noted upon admission to the hospital. Following a right hemithyroidectomy and upon returning to the hospital for a left hemithyroidectomy after the usual 6 week period, 21 of the 55 had established a regular rhythm, while 34 had continued to show fibrillation. The cardiac reserve is decreased in this group of patients and with the burden of hyperthyroidism added, operation very often carries with it such an increase in risk that a more conservative measure than complete subtotal thyroidectomy must frequently be chosen if we wish to avoid a mortality.

Toxic adenomatous goiter when subjected to surgery possesses a higher mortality rate than primary hyperthyroidism. As stated, the mortality rate for toxic adenomatous goiter over a period of 10 years has been approximately three times higher than that for primary hyperthyroidism. Several factors probably influence this higher rate, notably the duration of the disease has in many instances been longer and many of the patients are in the older age group—that is, past middle age. Possibly the lower percentage of stage operations in this group has affected the mortality rate, as previously pointed out, over a 10 year period from 1926 to January, 1936, only

ly decreased. In the later series of 56 patients, a mortality rate of 1.6 per cent was noted. One of the most valuable means of estimating the extent of operative procedure that can be safely performed in severe hyperthyroidism is the response to preoperative treatment in the hospital. In this clinic the preparation of the patient for surgery consists of a high caloric diet, iodine in the form of Lugol's solution, or drops three times a day, and adequate rest in bed. In certain cases the employment of sedatives is also a necessity. After the fourth day we do not confine our patients continuously to bed. They are allowed to be up and about for a part of each day. It is our experience that continuous bed rest is weakening and patients are made more fit subjects for pulmonary complications and for vascular accidents. The period of time needed for this preparation is dependent upon the course of the individual, most cases of hyperthyroidism require from 8 to 12 days, in others, the number of days necessary for preoperative care is indefinite and will depend upon the patient's progress. Patients who continue to lose weight in the hospital, whose pulse rate remains at high levels, are poor candidates for subtotal thyroidectomy. We believe that in such cases operation must be deferred until definite improvement is noted or until such a time has demonstrated that further improvement cannot be expected until surgery is carried out. We must consider these patients who show little or no improvement during the period of preoperative preparation to present definitely increased hazards and must plan our operation accordingly in stages, if a fatality is to be avoided.

From an analysis of the factors outlined one can estimate fairly accurately the amount of surgery which a patient can withstand without a fatality resulting, however, it happens not infrequently that one must reserve his estimate of the risk and finally make such a decision at the operating table. At this time we are aided materially by the experience of our anesthesiologists. They very frequently call our attention to certain reactions of the anesthetized patient, which assist them materially in estimating the intensity of the hyperthyroidism and indicate the necessity for more conservative measures. A steadily rising pulse rate to above 150 or 160 after the period of anesthesia induction is completed, should furnish a warning of a possible postoperative death. It is a complete subtotal thyroidectomy is persisted in in an anesthesiologist with great importance in indicating increased operative risk. The necessity for employing large amounts of gas oxygen mixture decreased. In the first series in this group of diabetic patients, 28 per cent had stage procedures whereas 17 per cent of the cases of primary hyperthyroidism had stage operations. Elderly patients with toxic stage operations frequently show surprisingly few clinical signs of severe toxicity and yet prove to be most serious operative risks.

Apathetic hyperthyroidism has been described from time to time by Dr. F. H. Lahey and the high risks attendant upon operation in these cases have been repeatedly emphasized by him. Apathetic hyperthyroidism (Fig. 3) in contradistinction to the usual activating type is characterized by apathy rather than activation. The gland is relatively small and firm and there is an associated low basal metabolic rate, frequently not more than plus 30. The pulse rate may run around 100 or 110 and these patients are usually as in activating type but on the contrary is cool, pigmented, and wrinkled. Because of the apparent mildness of the intoxication, one is tempted to proceed with a complete subtotal thyroidectomy and if done a fatality will almost certainly result. It is essential that a two stage procedure be planned for these apathetic cases if we wish to avoid a fatality and while they are not frequent, it is necessary that they be recognized. We have had 8 cases of apathetic hyperthyroidism in this series of 250 cases.

Attention has been called frequently to the seriousness of acute infection complicating hyperthyroidism. Any active infection, such as appendicitis, pyelitis, or acute streptococcal infection of the throat, may convert a moderately severe case of hyperthyroidism into a serious risk by suddenly intensifying the intoxication. A state of thyroid crisis may result and a fatality occur before surgery can be done. Operation must be postponed indefinitely in these cases and when undertaken must not infrequently be done in an emergency to avoid a fatal outcome. In this group of 250 patients there have been 3 cases of acute hyperthyroidism in children less than 10 years of age. We believe that a two stage procedure must be performed in a large percentage of cases of hyperthyroidism occurring in children, because of the tendency of children to have rather serious reactions after operation. Diabetic patients developing hyperthyroidism carry an increased mortality rate with operation. In a study of the cases with this disease continuation in the clinic a mortality of 4.8 per cent was reported in an earlier series of 63 patients. By the employment of 100 per cent more stage operations than in the first series in this group of diabetic patients, the mortality in the first series in this group of diabetic patients, 28 per cent had stage procedures whereas 17 per cent of the cases of primary hyperthyroidism had stage operations.

during the operation is a very positive sign of intense intoxication. Our anesthetists point out that the moderately toxic thyroid patient will require from 200 to 400 cubic centimeters of oxygen per minute, whereas the high risk patient will use 600 to 800 cubic centimeters of oxygen per minute and, in the face of these warnings, stage procedures must be employed to avoid fatalities.

From a review of this series of 250 patients upon whom a two stage procedure was carried out, it has been our desire not only to emphasize the significance of certain factors which we believe should make us consider stage operations but we have also been interested in the results obtained following a right hemithyroidectomy. We are presumably dealing with a more serious group of thyroid patients, and we wished to know if improvement could be obtained in a sufficiently large percentage to justify having the patient submit to two operations and also to justify the increased economic loss to the patient. We can positively state from our experience that the mortality rate can be lowered to an absolute minimum by the employment of stage operations and in our hands this has been the most important single factor in increasing the margin of safety for the patient intensely ill with hyperthyroidism.

It is significant that in this group of selected high risk cases there was not a single death following a right hemithyroidectomy nor did any fatality result from the second stage procedure which was performed 6 weeks later. As one would expect there was a small percentage of patients in this series who failed to show improvement, yet at the same time no patient progressed so far in the disease that he presented appreciably more risk upon his return to the hospital for his second operation than he showed when he came for the first stage. Almost without exception, convalescence was uneventful following a left hemithyroidectomy, which was the second and final stage and in no instance was there any postoperative reaction which in any way approached a state of crisis. Our study clearly shows that these patients were singularly free of any serious reactions following the second stage operation and we have learned to expect a smoother convalescence in our second stage cases than in the first stage cases. One can be reasonably certain aside from unpredictable complications, such as embolism or pneumonia, that death will not result from the second stage procedure since these patients have survived a more serious risk operation and are, for the most part, in greatly improved condition.

Following convalescence from a right hemithyroidectomy, these patients are discharged to

their homes for a period of 6 weeks. During this period they are directed to take iodine in the form of Lugol's solution, 10 drops once daily, and are also asked to follow a definite schedule of rest. It is of interest to note that of this group not a single patient failed to return for the second stage of the operation. In our entire series of thyroid operations we have had only 2 patients who failed to return for the final stage of the operation. Almost without exception these patients are appreciative of one's efforts to guard them against a fatality and such marked improvement was appreciated in a large majority of the cases that we have had no trouble in getting the patient to submit to the second operation.

From past experience we have arbitrarily fixed upon an interval of 6 weeks between stages. We have found that the edema and the exudative infiltration in the wound is entirely absent after that period and that reopening of the neck then is a much simpler technical procedure than if it were carried out at an earlier date. Also, during this interval the patient has had sufficient time to show all of the improvement obtainable from the first stage.

In a large percentage of the cases the improvement may be quite startling. Many of the clinical manifestations of hyperthyroidism may be absent upon their second admission to the hospital; activation may be lacking and the stare gone (Fig 4). One can expect a gain in weight. Pulse rate in most cases will have decreased and in many instances will have resumed a normal rate. Basal metabolic rate will have diminished and not infrequently have become entirely normal. Patients exhibiting mental changes from the intensity of the hyperthyroidism will show a remarkable improvement in their mental state. One frequently sees patients who to all intents and purposes have completely recovered—that is, the pulse is normal, the basal rate has reached a normal level and all clinical manifestations are absent. We should, however, in these cases proceed with the left subtotal hemithyroidectomy, because one can usually predict a recurrence of symptoms, often equally as severe as noted upon first admission if the second stage operation is unduly delayed. While we have no figures to substantiate a recrudescence of the disease to a state of its former intensity, a patient will, occasionally, be delayed beyond the usual 6 weeks interval and, upon returning for the second stage, symptoms will be evident which indicate a gradually renewed activity of the intoxication.

Patients frequently will show a remarkable gain in weight between stages, the greatest gain



Our study revealed also that we could expect a decrease in the severity of the hyperthyroidism as indicated by decreases in the basal metabolic rate—84 per cent of the 250 cases showed a definite drop in basal metabolism. We note here also a similar tendency to lack of improvement between stages in secondary hyperthyroidism patients as compared to the primary hyperthyroidism patients. Table IX gives figures for basal metabolism changes in both types of cases. In 45 patients the metabolic rate reached the range of normal

TABLE IX.—BASAL METABOLISM CHANGE BETWEEN FIRST AND SECOND STAGE HEMITHYROIDECTOMY—250 CASES

Total 2 stages per cent	Secondary per cent	Primary per cent	Drop in metabolism	Unchanged	Increased
84.8	76	90.7	80	11.0	13.2
20	10	13			

From a review of this group of 250 cases, we find that, while we can expect improvement in pulse, weight and metabolic rate in a majority of cases of primary hyperthyroidism following right hemithyroidectomy, we find also that secondary hyperthyroidism is apt to respond less favorably in as large a percentage of cases. This is in accordance with our experience that toxic adenomas present an increased operative hazard and operation carries with it a higher mortality rate than does primary hyperthyroidism.

#### SUMMARY AND CONCLUSIONS

- 1 Stage operations, such as a two stage right and left hemithyroidectomy at intervals of 6 weeks are still of great value in the surgical management of patients with severe hyperthyroidism.
- 2 The mortality rate in toxic goiter is proportional to the percentage of stage operations performed.
- 3 Factors which affect the mortality rate are outlined and an attempt has been made to indicate the influence of these factors upon the operative risk.
- 4 Figures are given illustrating the improvement or the lack of improvement following a first stage right hemithyroidectomy.

being 30 pounds in 6 weeks. Table VII shows the percentage of cases exhibiting improvement in weight between stages.

TABLE VII.—CHANGES IN WEIGHT BETWEEN FIRST AND SECOND STAGES HEMITHYROIDECTOMY—250 CASES

Total 2 stages per cent	Secondary per cent	Primary per cent	Gain in weight	Loss in weight	No change
82	75	86.5	11.4	14.8	13.2
5	20	2			

We have found that 82 per cent of this group showed a gain in weight of 1 to 30 pounds. It is also of interest to note that many of the patients who failed to reveal improvement in weight showed a drop in pulse rate and in basal metabolic rate. It is also of interest to note that patients with secondary hyperthyroidism exhibited a slightly decreased tendency to gain weight than in this series 75 per cent of toxic adenoma patients gained weight in contrast to weight gained in 86.5 per cent of the cases of primary hyperthyroidism.

There was also noted improvement in pulse rate in 73 per cent of the total series. In 60 cases, or 24 per cent, of the total series, the pulse rate decreased to a normal level.

TABLE VIII.—PULSE RATE CHANGE BETWEEN FIRST AND SECOND STAGE HEMITHYROIDECTOMY—250 CASES

Total 2 stages per cent	Secondary per cent	Primary per cent	Pulse rate drop	Pulse rate unchanged	Pulse rate increased
73.2	63	80	19	33	24.4
23	4	1			

We have found that secondary hyperthyroidism is less apt to show improvement in pulse rate than is primary hyperthyroidism. This same difference was noted in respect to weight gain.

# OLD UNUNITED CLAVICULAR FRACTURES IN THE ADULT

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THE literature on fractures of the clavicle and personal clinical experience give the impression that in the treatment of these fractures the profession is very indifferent—it is assumed that this type of fracture will always unite with a good enough result.

The angulation or deformity, which occurs more frequently than is apparently admitted and which is the result of vicious union or exuberant callus, is accepted as of little consequence.

Many authorities, even though there has been reported a goodly number of cases of vascular and nerve injuries, which may and do occur not only in comminuted but even in simple fractures, either ignore their possibility and importance or consider the possibility of such occurrence as negligible. In a general way I believe that the present day treatment of clavicular fractures, particularly in adults leaves a good deal to be desired. I am confident of this, because within a comparatively short period I have observed personally 9 cases of ununited clavicular fractures of long standing in adults. Of these cases 6 had brachial plexus involvement and 7 had to be subjected to open surgical treatment and correction owing to the disability to the patients. Recently one case of fracture of the clavicle with malunion and severe brachial plexus involvement was seen and operative correction was advised. With the ever increasing number of automobile accidents injury to the clavicle in the adult is becoming much more frequent and the nature of the injury is such as to favor non union or vicious union. Immediate surgical intervention appears to be indicated in many of these cases especially if there is marked displacement of the fragments which cannot be aligned and maintained by the usual conservative treatment of reduction and bandaging.

Among the few opinions expressed on this subject in the literature, is that of Chalmers who remarks that in some cases which were neglected at the initial treatment poor function resulted hence immediate operative treatment should be applied more often.

Verbrugge states that it is a mistake to consider clavicular fractures as of little consequence because their complications are numerous and may be late, the most serious among these being

compression of the brachial plexus, which is frequent—especially in comminuted fractures.

## THE CLAVICLE AND ITS CONNECTIONS

The clavicle is a key bone, which by its articulations with the sternum and acromial process of the scapula binds the upper limb to the skeletal trunk—it being the only bony connection between the arm and trunk. It serves to sustain the upper extremity in the various positions it assumes and also as a fulcrum to enable the associated muscles to allow lateral motions of great latitude to the arm. When the continuity of the bone is disturbed, all these functions in the arm suffer. Yet with vicious overriding, malunion, or callus formation, if not too exuberant, the function of the arm is often surprisingly good.

Children, as a general rule, can in time adapt themselves to a viciously united clavicle. Excess of callus often is absorbed, and the evolution by bone growth corrects angulation at the site of fracture.

Nature has strengthened every part of the bone except at the outer part of the middle one third, i.e., at the junction of the two curvatures of the bone. This is the thinnest part of the bone. It is not reinforced by ligaments or muscles and in most cases it is the site where traumatic fracture especially of the indirect type occurs.

The relations of the clavicle with the vessels and nerves in its vicinity are important in the case of fractures when injuries to these structures may occur. These relations are shown in the accompanying schematic drawings (Fig 1, A and B).

The brachial plexus, where it crosses beneath the clavicle comprises 3 main branches. Of these, two are anterior. One, external, originates from the fifth, sixth, and seventh cervical roots and forms the musculocutaneous and the external branch of the median nerves, the other internal originates from the eighth cervical and first dorsal roots and forms the internal branch of the median, the ulnar, and the internal cutaneous nerves. The posterior branch of the plexus forms the circumflex and radial nerves.

The frequency of injury to the brachial plexus and especially of ulnar nerve involvement in the author's series of 9 cases of fracture of the clavicle with non union and one case with malunion, led

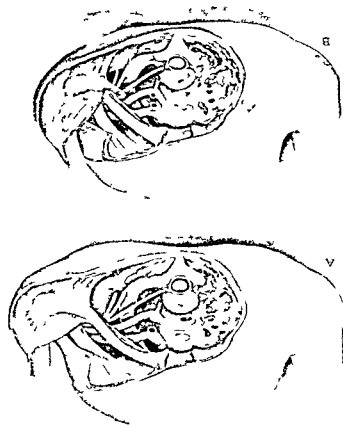


Fig. 1 A, B. The costoclavicular space and the important structures traversing it as seen from above and posteriorly. B The costoclavicular space and the important structures traversing it as seen from above and posteriorly. The clavicle has been fractured at the usual site and the shoulder displaced inward and downward. This shows the characteristic narrowing of the "costoclavicular space"

to a careful anatomical investigation of the relationship of the various structures involved. It was noted in the cadaver that the cord of the brachial plexus, which contains the components of the ulnar nerve, crosses the first rib directly under the middle third of the clavicle, while the other two cords are placed further to the lateral side and posteriorly. Hence, because of their position, they are less liable to injury. It was also noted that the space between the clavicle and first rib is more than adequate to accommodate the structures passing through it (Fig. 1, A). This space between the clavicle and the first rib will be referred to by the author as the "costoclavicular space." It is bounded below by the first and second ribs, the intercostal, serratus magnus, and subscapularis muscles. The lateral border of the pectoralis minor and that of the clavicle at the coracoid process. The base is toward the sternum at the line of fusion of the

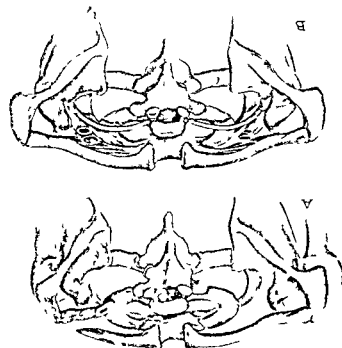


Fig. 2 A, B. The skeletal relationships of the outer fragment of the fractured clavicle. B Diagrammatic sketch which attempts to show the increased diameter of the structures traversing the costoclavicular space in the living, on the right side, as compared to the structures in the cadaver on the left. This demonstrates the relatively greater amount of space usually found in the cadaver. Conditions as to the adequacy of this space cannot be drawn from a study of this space only in the cadaver

costocoracoid membrane with the deep fascia over the upper intercostal spaces. The under surface of the clavicle and subclavius muscle form the anterior and superior boundary of this space. On careful dissection during operative intervention on the clavicle, the author has repeatedly noticed that this space is not as large in the living subject as it is in the cadaver. The explanation for this may be found in the fact that here the vessels are distended and that the dimensions of the cords of the brachial plexus are several times larger than they are in the cadaver (Fig. 2, B). Also this space is diminished by the elevation of the first rib by the scalenus anticus in the living. Hence, when the inner end of the outer fragment of a fractured clavicle is depressed, there is much less space between the first rib and the clavicle, with the result that the vessels and the nerves, especially the ulnar, are more liable to be subjected to pressure or irritation (Fig. 1, B). Previous to the summer of 1933 the author was of the opinion that fractures of the clavicle resulted in bony union except in the rarest of

# OCCURRENCE



Fig 3

Fig 3 Well formed mature cartilage adjoining synovial cells

Fig 4 False joint showing cleft lined with synovial cells. Underneath the synovial cells are to be found cap-



Fig 4



Fig 5

illaries which are lined with swollen endothelial cells.

Fig 5 Small blood vessels with swollen endothelial cells. The perivascular fibroblasts show the presence of proliferation

instances. From the scarcity of reported cases of old fractures of the clavicle with non union in adults in the contemporary literature, he was probably not unjustly holding an erroneous opinion in regard to the incidence of this complication. After having seen 5 such cases in the summer of 1933, this problem was discussed with several eminent orthopedic surgeons. Dr. John Ridlon stated that he had never seen such a condition. Dr. E. W. Ryerson had personally observed 2 cases of this type and Dr. Kellogg Speed had had experience with a few of these cases and was convinced that a bone graft was necessary for their cure.

#### ETIOLOGY

All of the author's cases resulted from exceptionally severe trauma. Four of the patients sustained fractures of the clavicle as a result of automobile accidents. Four of them occurred after the original fracture was sustained by severe direct trauma to the clavicle, and 1 resulted from a fall upon the shoulder.

Cases 1 and 2 were subjected to operation for acute fracture within 1 week after injury—Kangaroo tendon being used for internal fixation. Union might have been obtained in these 2 cases if reduction had been accomplished and adequate immobilization had been maintained.

In Cases 5 and 6 operation was done 7 and 5 months respectively after the original fracture. In Case 5 4 operations were done. Kangaroo ten-

don being used the first two times, a bone graft the third time, and wire at the fourth operation.

In Case 6 heavy braided silk was employed for internal fixation.

In Cases 5 and 6 fixation was not adequate after operation.

In Cases 3, 4, 7, 8, and 9 no previous operation had been done.

Four of the patients were in the third decade of life, 1 in the fourth, 3 in the fifth, and 1 in the eighth—the average age being 38 years.

There were 3 females and 6 males—a proportion of 1:2.

#### PATHOLOGY

**Location.** In all of the cases except one the fracture was at the junction of the middle and outer thirds of the clavicle, the one exception being near the external end of the outer third.

**Gross description.** In each of the cases as the site of the non union was approached, the fractured ends of the clavicle were found to be enveloped by a thick, firm, fibrous sheath. When this was opened, a few cubic centimeters of clear, thin yellow fluid escaped. The inner lining of the fibrous encasement was smooth and soft and had embedded in it at various places up to 2 millimeters in diameter, firm, grayish, smooth, shiny nodules which were grayish white in color.

In each of the cases there was found prominent bone spurs arising at the inferior and posterior aspect of the ends of the fragments.

Microscopic description of the pseudarthrosis, which was grossly described, is given with each respective photomicrograph (Figs 3, 4, and 5).

*Complication of non union of the clavicle.* In Case 4 there was an interference to the vascular return from the extremity. This resulted from pressure on the subclavian vein by the inner end of the outer fragment. The vascular phenomena were not constant in that they were altered with the change of position of the fragments.

Six of the 9, or 5 of the 7 patients operated upon, had complicating brachial plexus involvement. Definite structural injury to the plexus was not demonstrated in any of the cases. All recovered from the nerve involvement after restoration of the fragments to their proper alignment with the removal of the bone spurs, which were previously described, and the excess callus. The inference is that the restoration of the normal dimensions of the costoclavicular space relieved the brachial plexus from undue pressure or irritation.

In 1 patient (Case 9) who was not operated upon the brachial plexus involvement was present and the costoclavicular space was encroached upon by a calcified and ossifying mass, which was roentgenographically demonstrated.

*Symptoms of non-union of the clavicle.* Pain, which is usually along the course of the ulnar nerve, has been the most common symptom in this series of cases. Weariness of the intrinsic muscles of the hand has been a common complaint. A "clicking" sensation at the site of fracture on active motions of the arm has been a troublesome symptom.

On physical examination the findings were those of the characteristic deformity of angulation of the clavicle at the pseudarthrosis with the characteristic attitude of the shoulder which is dropped downward, forward, and inward. In all cases the false point of motion was present and weakness of the muscles of the arm and hand was frequently noted.

Parasthesia and anesthesia along the ulnar nerve distribution was common.

Vascular disturbance characterized by blueness and coldness of the entire upper extremity occurred in 1 case.

Roentgenograms revealed the malposition of the fragments, the overriding when present, the obvious non-union, the presence of a hiatus of 3 centimeters in 1 case and, when carefully studied, invariably bone spurs revealed arising from the inferior aspect of the fragments. Foreign bodies dense enough to cast a shadow were demonstrated in patients previously operated upon.

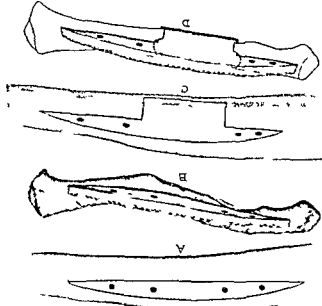


Fig 6 A, Outline of onlay bone graft on the tibia B, Autogenous osteoperiosteal onlay bone graft applied to fractured clavicle C, Outline of combined inlay onlay bone graft on the tibia D, Autogenous osteoperiosteal onlay bone graft applied to a fractured clavicle with a hiatus

# TREATMENT OF NON-UNION OF FRACTURE OF THE CLAVICLE

*Active.* In delayed union or non union cases or those in which there is marked deformity or interference with the function of the arm or hand, open reduction with union of the fragments by some method of osteosynthesis, such as bone grafting, is necessary.

In all the author's cases except 2, autogenous osteoperiosteal tibial bone grafts were used, the graft being applied laterally as an onlay graft at a point where the gap between the fractured bone ends were not great. A combined inlay and onlay graft was used when there was a considerable distance between the bone ends. The lateral graft (Fig 6, A and B) was used in Cases 3, 4, 6, and 7 and the combined inlay graft and onlay graft (Fig 6, C and D) in Case 5. In Case 1 a subperiosteal rib graft was used, while in Case 2 was utilized.

In all cases the periosteum should be dissected from the exposed bone ends for several centimeters and the bone ends should be cleaned of any exostoses and freshened. The ends should be hollowed out and the graft attached. Then the periosteum and soft parts should be sutured over



Fig. 7. Photograph showing the postoperative immobilization by a plaster shoulder spica.

the graft and the wound closed. In only one case was it necessary to shave off the inner end of the graft as it formed a projection under the skin. In no case was the graft removed.

At this time the author is unable to state what will be the ultimate fate of the graft: whether it will be absorbed by newly formed bone or whether it will itself remain viable. Although there has been internal fixation of the fragments by the massive osteoperiosteal bone graft, a most important part of the treatment in addition to internal fixation is that of external fixation by immobilization of the shoulder held upward and backward by means of a plaster shoulder spica from the time the wound heals until bony consolidation in good alignment is assured (Fig. 7). This usually requires about 12 weeks.

**Technique.** In order to avoid the disastrous complications of infection the operative field should have a 48 hour pre-operative preparation and then the operative area should be painted with iodine and alcohol at the time of operation.

After the shoulder and leg are draped a semi-circular incision is made below the clavicle from a point 1 inch lateral to the sternoclavicular joint extending nearly to the acromioclavicular joint through the skin, subcutaneous fat and platysma

muscle. This incision should be made so that the lowest point is at the level of the second rib; thus the line of incision will not be directly over the prominence formed by the graft. The flap is then turned up, and the skin edges are covered with towels most of the length of the clavicle with its muscular attachments being exposed. The periosteum is incised along the anterior superior margin of the fragments and is freed from them by subperiosteal blunt dissection, as the fractured ends of the fragments are approached, the fibrous tissue is dense and very adherent requiring sharp dissection. On the inferior posterior margins of the ends of the fragments there are found long bone spurs, which sometimes extend almost to the first rib. These bone spurs are found to be adherent to the fascial sheath of the nerves and vessels, hence should be removed with caution. On incision of the fibrous tissue between the fragments, a false joint is found to have developed in this location. After the ends of the fragments are freed for some distance the wound is covered with sterile towels. The tibia is exposed for a distance of 6 inches on its anteromedial surface through a longitudinal incision, and the skin margins are protected with towels.

The periosteum is not removed from the surface of the tibia and particular care is taken to leave it attached to the bone. The size, length and width of the graft which is necessary as previously estimated is marked out on the tibia with a sharp knife. With a motor saw the graft is cut from the tibia—the full thickness of the cortex of the bone being used. After the graft is freed but before it is removed from its bed four drill holes are made in it, placed so that there will be two drill holes to correspond to two drill holes in each fragment of the clavicle.

The graft is then removed from its bed care being taken not to remove any of the attached periosteum or medullary bone. Then the graft is applied to the anterior superior surface of the clavicular fragments so as to bridge the line of fracture. With the graft in place drill holes are made in the clavicular fragments to correspond with those in the bone graft, after a flat retractor is placed under the clavicle as a protection to the important structures beneath.

In Case 3 it was found, when the ends of the clavicular fragments were freed so the shoulder could drop back to its normal position that there was a hiatus of over 2 inches in the clavicle. It was decided therefore to cut the graft in such a way that it would have an additional lug on it, which could be interposed between the concave cut ends of the fragments. The exact fit the



Fig. 8 Preoperative roentgenogram, Case 3, reveals the marked separation of the ends of the clavicular fragment and inward displacement of the inner end of the outer fragment with some callus on the inferior surface of the outer end of the inner fragment.

firm bony union justified this plan and procedure. The onlay bone graft is secured in position by heavy chromic catgut sutures, which are passed through the drill holes in the clavicular fragments and through the corresponding drill holes in the graft and tied around both.

The periosteum, closed over the fragments by a continuous suture of strong chromic catgut. The wound is closed without drain, with a continuous suture for the subcutaneous tissue and with black silk for the skin.

The patients are placed on a flat, firm bed without pillows, but with a folded blanket between the shoulders after a snug Velpeau bandage is applied. The sutures are removed in 2 weeks and then a plaster shoulder spica, which extends from the wrist to the axillary creases, is applied with the elbow flexed to a right angle, thus holding the shoulder upward and backward as far as possible. The patients are then ambulatory for 10 weeks, after which the spica is removed provided bony union is demonstrable.

# CASE REPORTS

CASE 1. M. W., female, aged 28 years, entered the hospital May 28, 1933, on account of pain in the region of the left shoulder and clavicle. Motions of left arm caused a "clicking" sensation at the site of the old fracture of the clavicle. After sleeping on the left side she noticed paralysis of the entire left arm. About 1 year before she was in an automobile accident and sustained a fracture of the left clavicle, which was set and a "T" splint was applied. One week later she had an open reduction. No splint was applied, but she was kept in bed 11 weeks. Physical examination revealed the characteristic deformity of shoulder with non union of clavicle at junction of the outer and middle thirds. On May 29, 1933, she was operated upon according



Fig. 9 Roentgenogram which was taken 3½ months after operation. Case 3 reveals a definite improvement of the position of the clavicular fragments, which are united by solid bony callus. It also reveals the increased width of the costoclavicular space. The osteopetrosal onlay graft with its four drill holes is of approximately the same density as that of the underlying clavicle. It is firmly united along its course to the clavicle.

to the previously described technique, a fragment of rib being used as a graft. On June 4, 1933, patient was discharged from the hospital with the plaster shoulder spica. Three months later, after operation, roentgenograms revealed firm bony union of the fragments.

CASE 2. E. F., male, aged 29 years, entered the hospital September 18, 1933, on account of pain at the site of the old fracture of the left clavicle radiating over the scapula to the chest and down the arm. On November 22, 1932, he was struck a severe blow with the handle of a pick, over the left shoulder fracturing the clavicle and causing numbness of arm. At open reduction on November 25, 1932, the fragments were fixed with kangaroo tendon and a Velpeau bandage was applied. Examination revealed a prominent middle third of the clavicle. Roentgenograms demonstrated an old ununited fracture of the clavicle at the junction of outer and middle thirds with displacement of the ends of fragments. On November 14, 1933, a sliding osteopetrosal graft was done and an abduction splint was applied for 2 weeks. On December 28, he fell out of bath tub and injured clavicle again. Cephalic swelling, and discoloration were present. A plaster shoulder spica was applied until April 16, 1934, when roentgenograms revealed bony union.



Fig. 10 Roentgenogram Case 3, 2 years after operation demonstrates solid bony union with disappearance of the onlay graft. There is hypertrophy of the clavicle with restoration of the costoclavicular space.



Fig 11 Pre-operative roentgenogram of patient F. H. Case 4 reveals the characteristic malposition of the clavicular fragments with the tendency to develop spurs at their ends 1 year after injury. The shoulder girdle is relatively lower and the costoclavicular space is diminished. There is no evidence of callus formation.



Fig 12 Post-operative roentgenogram Case 4, 19 months after operation reveals normal alignment of the former fracture site with solid bony union. The osteoperiosteal onlay graft used has become fused with the underlying clavicle and is apparently of the same density. The ends of the graft merging with the callus from the superior aspect of the clavicle give the appearance of adaptation to the contour of the clavicle. The shoulder girdle is in normal position and the costoclavicular space is of normal width.

CASE 3: I male aged 25 years was struck on right shoulder July 5, 1933 by a falling steel beam which caused a fracture of the clavicle and multiple other injuries. The arm was bandaged over the chest. On November 20, 1933 patient came to the author's service complaining of weakness of the right arm, numbness of the little and adjacent half of the ring fingers, and old fracture of clavicle with non union and discoloration of the fragments. Examination revealed the false point of motion and roentgenograms (Fig 8) demonstrated rather marked separation of the fragments. On December 5, 1933 open reduction was accomplished according to the technique described. On March 24, 1934 roentgenograms (Fig 9) revealed bony union between the fragments and between the graft and fragments.

Roentgenograms (Fig 10) taken 2 years after operation demonstrate solid bony union.



Fig 13 Pre-operative roentgenogram Case 5 reveals the condition of the fracture of the clavicle 5 1/2 years after the original fracture and 15 months after the fourth operative attempt to repair the non union. The clavicular fragments appear to have good alignment. There is a hiatus of approximately 3 centimeters with a loop of wire lying free between the ends of the fragments. The inferior posterior bone spur on the inner end of the outer fragment is clearly visualized. This spur diminishes the costoclavicular space.

CASE 4: F. H. female aged 41 years, entered hospital December 14, 1933 complaining of weakness of the arm and pain over the middle of clavicle which resulted from fracture of the right clavicle sustained in an auto accident about 1 year ago. Physical examination revealed the non union of the fractured clavicle at junction of middle and outer thirds (Fig 11). The arm became cold and blue when dependent. December 12, 1933 open reduction was accomplished according to the technique described. Twelve weeks later roentgenograms (Fig 12) revealed bony union with normal position of the fragments. The subjective and objective symptoms have not recurred since the operation.

CASE 5: K. male aged 40 years, entered the hospital complaining of pain and weakness on using the right arm which resulted from an injury in November, 1920, when a large roll of paper fell on him causing multiple injuries, in



Fig 14 Roentgenogram Case 5, taken 3 months after operation reveals normal alignment of the clavicle with solid bony union of the inlay-onlay osteoperiosteal bone graft to the previous clavicular fragments with restoration of normal length to the clavicle. The shoulder girdle is in normal position and the costoclavicular space is restored.





Fig 16

Fig 15

Fig 15 Roentgenogram, Case 10, demonstrates fracture of the clavicle with mal union and vicious callus. The posterior displacement of the inner end of the fragment, which approximates the first rib diminishes the costoclavicular space. This view was obtained after a special study of the case with a portable "stock proof" unit of a fluoroscope, and the roentgenogram was taken with the tube at about the level of the fifth rib anteriorly pointing upward and backward with the plate in position above and behind the clavicle. In this case it will be noted that the costoclavicular space is encroached upon by the displaced fragment of the clavicle, hence the complication of the neurologic symptoms.

Fig 16 Roentgenogram Case 10 of the costoclavicular space on the normal side. Roentgenographic technique is the same as in Fig 15.

cluding fractures of both legs and right clavicle. The fractured limbs were treated by casts but the clavicle was not treated, as he lay in bed for 10 weeks.

In May 1930, he had open reduction of the fractured clavicle with immobilization by bandage for 9 weeks. This was repeated in June, 1931, and in October, 1931, the clavicle was operated upon again with a bone graft. Although he again remained in the hospital 10 weeks no cast was applied. In November, 1933, he entered the same hospital again and remained for 11 weeks, having had an open reduction with wiring of the ununited fragments. This was before he entered the author's service May 2, 1935.

On physical examination May 2, 1935 the right shoulder was found to be lower than the left, nearer the midline and somewhat anterior. There was a false point of motion in the mid portion of the clavicle and roentgenograms demonstrated the old ununited fracture in the middle of the right clavicle—the middle third was missing—with the shadow of a wire loop free between the ends of the fragments.

On May 4, 1935, we operated according to the technique described. On removing the loop of wire and freeing the fragments so that the shoulder could drop back into its normal position there was a gap of over 2 inches between the ends of the fragments. The only graft technique did not appear to be a sufficient procedure, so it was decided to cut the long graft from the tibia with an extending "Jug" at its middle portion which could be applied to the fragments as the onlay portion was sutured between the fragments as the onlay portion was applied to the fragments (Fig 6, C and D). Roentgenograms taken 3 months after operation revealed solid bony union of the graft to the fragments.

Case 6 Z, male, aged 33 years, entered the hospital March 26, 1935, because of brachial plexus symptoms as which resulted from injury in an automobile accident June 5, 1934. He had only partially recovered from partial paralysis of the right arm. On October 29, 1934, open reduction was done, but he still complained of the nerve complication. On March 26, 1935 he was admitted to the author's service and was operated on again March 28,

July 15, 1935 at which time he complained of weakness of the right hand with ulnar paresthesia. He injured the right shoulder on March 8, 1933, in an automobile accident which resulted from injury in an automobile accident patient developed pain and paresthesia along the ulnar nerve. Roentgenograms revealed ununited fracture of the outer third of the clavicle with a shadow of an ossified hematoma in the costoclavicular space.

Case 9 Dr K J, male aged 70 years, was first seen on July 15, 1935 at which time he complained of weakness of the right hand with ulnar paresthesia. He injured the right shoulder on March 8, 1933, in an automobile accident which resulted from injury in an automobile accident patient developed pain and paresthesia along the ulnar nerve. Roentgenograms revealed ununited fracture of the outer third of the clavicle with a shadow of an ossified hematoma in the costoclavicular space.

Case 8 J, female, aged 20 years, complained of tired sensation in her arms, especially the right. All motions of right arm caused a clicking in the right collar bone. She was injured in auto accident January 30, 1935, sustaining a fracture of both clavicles and tibia. Treatment consisted of rest in bed for 1 month as the tibia was immobilized in cast. Examination revealed a diminished distance between both shoulders, which were more anterior than normal. There was an increase in size of the middle third of the left clavicle while in the middle of the right clavicle there was a false point of motion. Roentgenograms confirmed the malunion of left clavicle and non union of right clavicle as the patient consulted the author on January 11, 1936. Operative reduction of the non union with tibia bone graft was advised.

Case 7 S, male, 43 years of age, entered the hospital on September 8, 1935 complaining of pain and weakness of the right arm as a result of old fracture of the clavicle with non union, which was the result of one of many injuries sustained on February 28, 1935, when a wheel and cable of falling elevator struck him. On examination there was found non union of an old fracture of the clavicle. On September 10, 1935 open operation according to described technique was done. Three months later roentgenograms revealed good position of fragments with bony union of fragments and union of graft to the fragments.

Case 10 S, male, 43 years of age, entered the hospital on September 8, 1935 complaining of pain and weakness of the right arm as a result of old fracture of the clavicle with non union, which was the result of one of many injuries sustained on February 28, 1935, when a wheel and cable of falling elevator struck him. On examination there was found non union of an old fracture of the clavicle. On September 10, 1935 open operation according to described technique was done. Three months later roentgenograms revealed good position of fragments with bony union of fragments and union of graft to the fragments.

**CASE 10** Male 38 years of age, sustained an injury of the right shoulder November 1 1935 when a plank fell on his shoulder. He had pain and loss of function for a few weeks after which he had no complaint until December 15 1935 when he began to develop weakness of the arm with tingling and pain in the hand. On examination there was found marked atrophy of the muscles of the arm and marked loss of strength while roentgenograms revealed an old fracture of the clavicle which had firmly united with the characteristic deformity and excess of callus.

Operative correction of malunion was advised.

#### SUMMARY AND CONCLUSION

1 The literature on fracture of the clavicle with non union is limited and opinions as to treatments are rare.

2 In the treatment of old ununited clavicular fractures in adults the use of the tibial bone graft with immobilization is recommended as the method of choice.

3 The costoclavicular space is diminished in the living as compared to the cadaver, because the vessels are distended and the nerve trunks are larger. In fractures of the clavicle this space is further diminished by the posterior displacement of the inner end of the outer fragment.

4 The inner cord of the brachial plexus which contains the fibers of the ulnar nerve passes down

ward to the arm directly over the first rib under the clavicle, while the other cords of the brachial plexus are located lateral to the first rib where there is a wider space and hence there is less liability of injury or later irritation.

5 The presence of the bone spurs, which were constantly found, although not always demonstrated in roentgenograms, because of their position, can be explained by the deposit of new bone from the periosteum, which was stripped from the clavicle by the force producing the original fracture.

6 The technique of the operation, which gave 100 per cent of successful results, is described.

7 A technique for taking roentgenograms more clearly to demonstrate the costoclavicular space is described.

8 Six of the 7 patients operated upon had preoperative neurological symptoms.

9 One patient with malunion, vicious callus, and late neurological complications, is reported.

10 A report is given of 9 personal cases of old fractures of the clavicle with non union in adults, 7 of whom were operated upon according to the method described, with cure of the non union and its associated complications.

## FRACTURES OF THE NECK OF THE FEMUR

Fixation by Means of Kirschner Wires or by Smith-Petersen Nails

N. BACKER-GRONDAHL, M.D., Bergen, Norway

**I**N the October, 1936, issue of SURGERY, GYNECOLOGY and OBSTETRICS, there appears an article by Frederick G. Dyas and Leon J. Ames in which they describe a method for the treatment of fractures of the neck of the femur by means of Kirschner wires. They found the method an easy and safe means of fixation of the fragments.

The same method has been used for several years in the Surgical Department of the Municipal Hospital of Bergen, and we know that the method



Fig. 1 B H, female, aged 65 years October 25 1932  
Fig. 2 Reduction and "needling," November 9 1932

has also been used by Schilling, director of the Surgical Department of the Municipal Hospital of Oslo, independent of us and without any knowledge that we used the method. The technique was the same as that described in the article by Djas and Arnes. At first the results were very promising. Difficulties developed later, however, which made us abandon the method, entirely.

In our early cases, burned needles were used, but we found that the needles traveled, as happened in the following case. Director Schilling of Oslo had a similar case

A woman, 65 years of age, had a subcapital fracture of the neck of the femur (Fig. 1), which we set by introducing the

Director Surgical Department Municipal Hospital

1073

and weak subjects

After this experience we gave up using buried needles. We left the end of the needle outside the system and held it in place with a metallic knob. With this method, however, there was the danger of infection. One of our patients had an osteomyelitis which terminated fatally.

Although the method of using needles in the fixation of fractures of the neck of the femur has certain advantages, as pointed out in the article by Dyas and Arnes, we have given up using it entirely. For many years we have been using instead the Smith-Petersen nail—with flanges—and have come to use the technique worked out by Johanson. We have found this method to be far superior and without danger even in very old and weak subjects.

[illegible]

## FRACTURES OF THE PATELLA

GEORGE W. HAWLEY, M.D., F.A.C.S., Bridgeport, Connecticut

FOR the past 15 years, my associate, Dr. A. S. Griswold, and I have been using a method of treating fractures of the patella which has proved very satisfactory. During this time the method has been used as a routine measure with little variation in more than 100 cases.

The principal features of the method are these: No immobilization is used after operation. Voluntary motion is begun on the fourth day and walking without support on the seventh to the tenth. By the fourteenth day the knee is without dressing or protection, at which time there is free flexion of 60 to 90 degrees. Return of full motion, strength, and use averages from 3 to 6 weeks. The results run true to form with striking uniformity.

### THE METHOD

Briefly, the technical features of the method are as follows: After being roentgenographed the leg is supported in temporary splints, the anterior surface of the knee being left exposed for careful preparation of the skin for operation and for the application of an ice bag to promote hemostasis. On the third to the fifth day, the fracture is exposed through a liberal vertical incision and the skin is retracted laterally and anchored with two strong towel clips to the sides of the knee, thus making the exposure diamond shaped. The skin is excluded from the field with sterile handkerchiefs fastened over the skin edges with Michel clips so that no skin is exposed. Only instruments and untouched materials come in contact with exposed tissue. Surgical trauma is limited. The internal part of the joint is not explored or invaded. Only the superficial blood clots are removed, the deeper ones are left. The fracture surfaces are carefully examined and the thin, adherent blood clot, usually present, is carefully and thoroughly removed with a small curette. As a rule, it will be found that the aponeurosis over the patella has been torn at a different level and overhangs one fragment. Two drill holes are made in each fragment and pointed dividers are used to space the holes so that they will match, one fragment against the other. Two short

strands of strong Ajax wire<sup>1</sup> are threaded through the holes to make two simple loops. This wire in quality is malleable, tough, easy to handle, and does not break or crack. Great care is used to draw each loop as tight as possible to impact the fracture surfaces. This we believe is important. Several twists make a strong knot which is cut, not too short, bent laterally, and buried under the aponeurosis to prevent protrusion under the skin. The torn aponeurosis and lateral expansions are sutured with catgut and the skin is closed.

Over the sterile dressings protecting the wound a very generous amount of absorbent cotton is applied, from midcalf to midthigh. Strong muslin bandage is used over the cotton and applied to compress the cotton firmly, especially over the joint. This helps to prevent and limit secondary exudate into the knee. Considerable pressure can be used without interfering with circulation, the cotton being compressible, soft, and fitting evenly the contour of the limb.

### AFTER TREATMENT

On the fourth day the muslin bandage is removed, the cotton is loosened and a loose gauze bandage is substituted. The patient is then asked to bend the knee. As a rule he can flex it from 10 to 20 degrees. At first, somewhat apprehensive, he is pleased to find he can get some motion. He is also requested to contract the quadriceps muscle and is instructed to practice frequently both joint motion and quadriceps contraction. He is warned that pain and fatigue are signals for him to go slow. He is cautioned to proceed slowly in his efforts to regain motion. At no time is passive motion used. The man is encouraged to work his own "motor" and work out his own salvation. Day by day the range of motion increases. This has a favorable psychological effect on the patient. The fact that he can see improvement encourages him and he takes pride in his progress.

It has been interesting to observe that, in some cases, voluntary quadriceps contraction is at first feeble, but this inhibition is transient and soon disappears. As a rule voluntary quadriceps contraction is spontaneous and immediate without

<sup>1</sup>There are different sizes of this wire. Some are too light for the purpose. Gauge No. 18 has the necessary strength without being too clumsy and heavy. Ajax wire is a high quality rust proof stove wire.

From the Orthopedic and Fracture Service of the Bridgeport Hospital. Presented at the Symposium on Fractures at the University of Pennsylvania Hospital by members of the Fracture Committee of the American College of Surgeons, during the Clinical Congress of the American College of Surgeons, Philadelphia, October 19-23, 1936.



Fig. 1, left. Roentgenogram of recent transverse fracture of patella from indirect violence showing double wires and even alignment of posterior articular surface of patella. Patient out of bed seven days, home on tenth with good knee motion, and full function end of fourth week.

grams showed that the wires held and the fracture occurred at a level below the wires, the wires proving stronger than the bone. Thus it turned out to be a new fracture and not a refracture. In 2 cases, quite similar, fracture of the patella occurred in existing partial ankylosis of the knee following prolonged immobilization after compound fracture of the femur with infection and subsequent chronic osteomyelitis. At operation adhesions in the joint were found. These came into view without undue exploration and were divided. Both patients increased the range of motion, 1 from 70 to 90 degrees and the other from 60 to 75 degrees.

Another had tabes, which was overlooked until after operation and recognized only when absence of pain and ataxia became apparent. The patient let her leg drop and the wires tore through the softened tabetic bone. There have been a few cases with, at a later date, fracture of the opposite patella and 2 cases of simultaneous fracture of both patellas. In one, both patellas were wired. The other presented a mid-transverse fracture of the right patella and a subpatellar fracture of the tip of the left. One was wired and the other was not. The wired patella recovered full use in 2 months. The other remained unstable and weak for more than twice as long.

An intracapsular softening of bone substance sometimes occurs in tabes, but with little or no change in internal structure as shown by roentgenographic examination. Spontaneous fractures occasionally occur in this disease.

The absence of the usual controlling protective mechanism is an interesting feature. It would appear that nature finds little need to establish protection and inhibit motion. The necessity diminishes with the restoring of tensile strength in the patella and does not exist when the strength equals the normal. Patients soon find they have the ability to bend the knee and sense the feeling of returning power. It is then often difficult to restrain them. When they find they can, they do, which is not surprising. After the fifth day, if he feels the urge and has the confidence, the patient is allowed to get out of bed and walk without support, except a cane moved.

# RECOVERY

It has been surprising how rapid the recovery of function has been in some cases. In one case a machinist returned to his regular work 2 weeks after operation. A structural ironworker, whose work required climbing ladders and walking narrow beams, was back on the same job in 3 weeks. One man insisted on leaving the hospital on the fifth day and was at his desk on the tenth. Nothing would stop him. These are simply statements of fact and not made to convey the impression that coercion is used or advocated, or that such early use is to be expected or sought. On the contrary the patient is cautioned neither to hasten progress, nor to hold back. Our experience has been that the patient, all in all, is a better judge of what he can do than is the surgeon, and no harm has come from letting him be his own judge.

The rule has been that return of motion is rapid and prompt in all patients, with little variation. On the other hand there is more variation in the return of power and use in spite of free motion. Some patients are slower than others in this respect. Some delay is common in neurotic subjects, the timid, and uncooperative, those whom hands are more occupied with the settlement of a damage suit, and those not naturally "self-starters."

On the whole, the occupational recovery occurs on an average in from 3 to 6 weeks. In some cases the period has been 2 months and in a few cases 3 months, but in the majority of cases the recovery period did not exceed 6 weeks.

There have been a few particularly interesting cases. In one instance, only one, apparently refracture occurred. This was in a man who returned to factory work 3 weeks after operation, and 2 weeks later slipped on an orange peel. It was thought that the wires had broken but roentgen-



Fig 3

Fig 3 Roentgenogram of a recent comminuted fracture result of direct violence and due to impact of flexed knee against dashboard of motor car. Showing preading of fragments.

Fig 4 Roentgenogram of same case (postero-anterior view) showing wire loop through upper fragment and patellar ligament encircling and drawing fragments together.



Fig 4



Fig 5

Fig 5 Roentgenogram of same case (lateral view) showing correction of separation of quadriceps tendon from patellar tendon. Wire appears as a figure of 8 because two tied end is bent laterally. Patient up at the end of second week, home at end of third week, 90 degrees flexion 6 weeks after operation. Patient returned to work 2 weeks later.

#### COMMUNUTED FRACTURES

The foregoing relates to the common type of transverse fracture due to indirect violence. In the comminuted or stellate type produced by direct violence, the double wiring is already



Fig 6 Photograph of same patient 2 months after operation just before return to work.



Fig 7 Photograph of a patient 10 days after operation showing knee flexion and quadriceps strength. Gauze is used to protect skin wound. Author's case taken from Scudder's textbook *Fractures*.

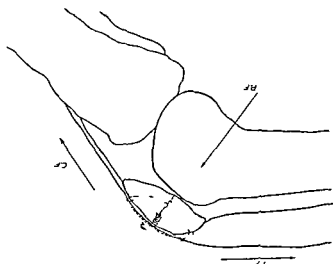
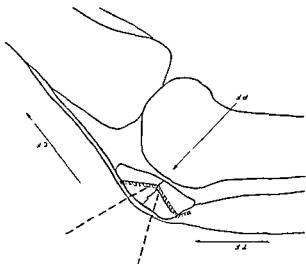


Fig 8 Tracing of roentgenogram of a knee in partial flexion—the "rocking" position. Three forces are exerted on the patella, (1) *TF*, the traction force, (2) *CF*, the counter traction force, (3) *PF*, the pressure force. The last is the force which produces the transverse fracture of the aponeurosis tearing and the patella cracking from front to back. It is also the force which tears and induces the strength of the wire fixation. The two wire loops reinforce the patella in front where the strain is greatest and the four vertical strands of wire give double strength both in front and back.

described is not applicable. In these cases a wire loop is used encircling the fragments. This tends to correct the spreading pieces of bone, drawing them together like a picture puzzle and provides a fairly strong and satisfactory approximation. The wire is passed laterally through the upper or lower fragment to get bony anchorage. The after-treatment is much the same as in transverse fractures. No splints are used. They have not been found necessary. The natural protective inhibition automatically limits beneficial motion, if observed, and the limits cannot be exceeded without reprisals.

These patients first walk with crutches for a short time, changing to a cane. Progress is slower than in the transverse fractures. The approximation has not the same tensile strength. As a rule, however, the majority of these cases recover 90 degrees of flexion in 2 months, a few require 3 months. Many return to work in 3 months, some in 4, but few take more than that. That recovery is sometimes quite rapid in these cases is illustrated in a recent case of extensive fragmentation due to the impact of the patella against the dash of a motor car. The patient left the hospital on the tenth day and had free flexion and walked without a cane 2 weeks later. The comminuted type of fracture has been more common, actually and relatively (in relation to the transverse type), in the last few years. Our

Fig 9 Tracing of roentgenogram showing the single mattress loop. The strength of this method of fixation rests in the two strands of wire placed near the posterior surface of the patella. The pressure force from behind acts to open and separate the fracture line in front and when this happens the wires put in at an angle straighten out and separate the fragments. Mechanically, this is an imperfect method of approximation.



records for the past year show no fractures of the patella of which 6 were comminuted and 4 transverse. This reverses the proportion of years ago, due in large measure to automobile accidents where the flexed knee is driven against the dash-board.

#### SUMMARY AND CONCLUSION

It is our belief that a patella doubly wired with strong wire is as strong, or stronger, than a normal patella, that a man can start motion as soon as the wound is healed, and that there is no reason why he can not. The fact that in one case of apparent refracture the wires held indicates that the double wires are stronger than the bone. Our rule has been to wire all patellas unless the subject is a poor surgical risk. Fractures with little separation are wired, on the basis that it promises much earlier recovery of use and escape from tedious convalescence and splints and plaster.

The wires are not removed. Removal is at the discretion of the patient who is told that the buried wire is harmless, that, if by chance, it becomes troublesome, removal is simple. As yet, no occasion has arisen necessitating removal of the wire. While the effort has been to secure accurate alignment of the fragments by drilling from the fracture surfaces, no interference with function has yet been observed due to irregularity of the posterior articular surface.

It is our opinion that metal of most any kind burned in bone is harmless, if the surgical trauma is not excessive and the technique precise, that the idea of the harmfulness of metal *per se* is without basis of fact, that erosion of bone around a screw or wire is caused by low grade infection, that the blame has been mistakenly put on the metal and not the surgeon. We have not observed erosion of drill holes or loosened wire, clinically or roentgenographically.

It cannot be denied that non operative treatment many times results in perfect recovery. But what an unnecessarily long time to wait, to protect and nurse a weak leg, before return to active life! The sacrifice is great and few choose it, unless consideration exists which make it advisable.

The wiring operation with drilling of bone is old but has been abandoned to some extent due in part to illogical antipathy to the use of wire, to the fact that wire sometimes breaks, and to fear of infection. Silver coin silver, has been more often used but this frequently breaks in applying or afterward. Usually applied as a single mattress loop its strength rested in a single strand. When used, it has been as a suture having more strength than heavy silk or gut and with little thought that a wired patella could be made to stand the strain of early motion or use.

The method of wiring herewith described differs only from the old in that a wire of proved strength and adaptability is employed, two loops are used instead of one the fracture surfaces are impacted and artificial restoration of patellar strength is aimed at.

Formerly, the surgical objective was simple approximation of the fragments, but it can go a step farther. Instead of simple approximation, it is possible to effect at once a union of the fragments strong enough so a man can use the leg while the slow process of repair is going on within

the knee. It is our belief that complete natural repair with restoration of patellar strength takes many months. This explains the tedious recovery of strength and usefulness after surgical approximation with weak sutures, in the unoperated upon patients with little separation, and the occasional occurrence of refracture during the first 6 to 12 months.

It is important to preserve the function of the quadriceps muscle, both its contractile and its elastic property. Both are quickly impaired through immobilization, neglect, and disuse. The loss of elasticity retards knee flexion and puts an extra strain on the injured patella.

The operation for repair of the patella is really a tenorrhaphy and the lesion partial or complete rupture of the quadriceps tendon, though it happens that the tear takes place through a bone as part of a tendon, which fact the surgeon can use to good advantage. Anatomically and physiologically the patella and patellar ligament are part of the quadriceps tendon, the patella placed behind acting to guide the tendon in the intercondylar groove. The anterior surface of the patella is an intimate part of the quadriceps aponeurosis. The posterior surface is covered with cartilage. Strictly speaking, it is not a true sesamoid bone imbedded and enclosed in a tendon.

Fractures of the patella and olecranon are the best examples where the ideal of fracture treatment can be applied and observed, that is, immobilization of the fracture surfaces, and mobilization of the entire limb at the same time.

To the injured man, especially the industrial worker, and the industry and insurance company which carry his liability, short convalescence and early return to work are important considerations. For the surgeon the obligation exists not only to repair the injured patella, but to put the man in the way to resume his occupation at an early date.







Fig 1 Case 1 E H aged 12 years Roentgenograms taken 2 years 7 months after resection of right radial head. Radius is short at wrist. Patient had severe and protracted wrist symptoms at this time.

flexion of the elbow a definite click is felt in the region of the upper extremity of the radius. Roentgenograms of the wrists show moderate shortening of the left radius as compared with the right. Films of the left elbow show that a small new radial head has formed which articulates with the capitulum (Figs 6 and 7).

CASE 5 D F No H10-823 female aged 9 years at time of operation. Patient came to the hospital June 15 1932 with a history of fracturing her right elbow 6 months before. Three days after the injury she was operated upon in another hospital. Following this she had a moderately stiff elbow with limitation of all motions. Operation in this hospital July 1 1932 consisted in removal of the head of the radius. Recovery was uneventful and she was discharged July 5 1932. She was seen by us February 6 1936 at which time she stated that the result was satisfactory to her. Examination showed an increased carrying angle of the right elbow. Flexion extension and pronation were normal. 50 per cent limitation of supination. The radius appeared markedly shortened at the wrist with much radial deviation of the hand. Roentgenograms of the

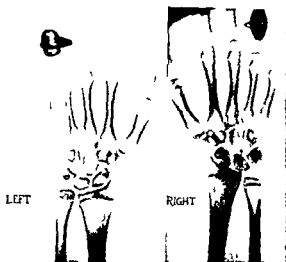


Fig 2 Case 2 J W aged 14 years Roentgenograms taken 11 1/2 months after resection of the left radial head. The radius is short at the wrist. No wrist symptoms were noted.

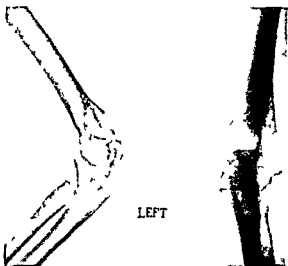


Fig 3 Same patient as shown in Figure 2

wrists show that the right radius is very short of the right elbow that there is slight expansion of the upper end of the radius and this appears to impinge against the lateral side of the coronoid process with a space between it and the capitulum considerably greater than the humero ulnar joint width (Figs 8 and 9).

CASE 6 R T No B12-708 male aged 16 years at time of operation. Patient was seen January 16 1928 and gave a history of falling and injuring the right elbow 8 days before. Roentgenogram showed fracture of the head of the radius. He was treated conservatively. April 13 1928 the head of the radius was excised because of limited elbow motion. He remained in the hospital under treatment for persisting limitation of elbow motion until June 27 1928. On discharge he had only 135 degrees of exten-

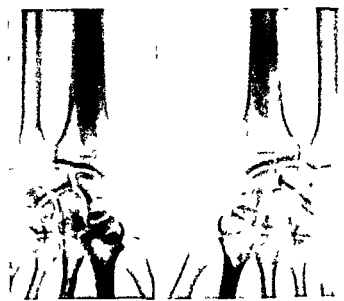


Fig 4 Case 3 V D, aged 21 years. Roentgenograms made 3 years 10 months after resection of the left radial head. The radius is short at the wrist. There are no wrist symptoms

He stated that he had always had some limitation of extension. The arm bothered him when he carried heavy objects. Because of pain in the elbow and the wrist when shifting gears, he has had to give up his occupation as chauffeur. He has also noticed that he has a prominence on the inner side of his wrist, which is getting larger. Extension and flexion of the arm is normal. There is a slight limitation of pronation and supination, and extension is limited to 140 degrees. The hand lies in definite radial deviation, with the lower end of the ulna more prominent than in the other wrist. Roentgenograms show moderate shortening of the right radius at the wrist. The pointed upper end of the radius articulates with some unidentified bony body just below the capitellum, which prevents any further upward displacement (Figs 10 and 11)

Fig 6 Case 4 R G, aged 21 years. Roentgenograms taken 7 years 4 months after resection of the left radial head. The radius is short at the wrist. No wrist symptoms are noted

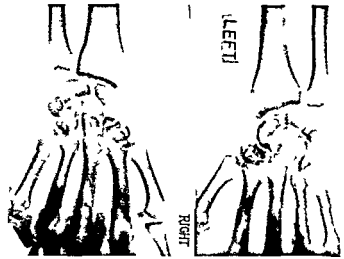


Fig 5 Same patient as shown in Figure 4. Showing traumatic accessory bone

CASE 7 V B, No History, aged 12½ years at time of operation. She was admitted to the hospital July 25, 1934 with history of fracture of the right elbow on July 13, 1934. X-ray examination showed a fracture of the radial head in bad position. Operation July 26, 1934, consisted in removal of the head of the radius. Convalescence

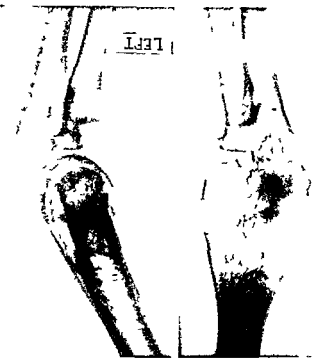


Fig 7 Same patient as shown in Figure 6

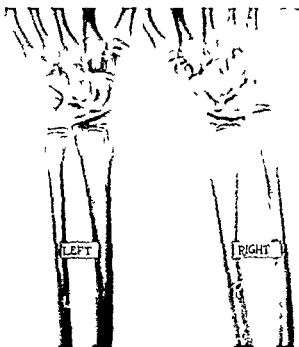


Fig 8 Case 5 D F aged 12 years Roentgenograms taken 3 years 7 months after resection of the right radial head. The radius is short at the wrist. No wrist symptoms are noted.

cence was uneventful and on discharge August 8 1934 there was satisfactory motion. She was seen by us April 18 1936 and stated that she had been well since operation with no complaint except that her arm tired easily when she carried heavy objects. She says that she has normal

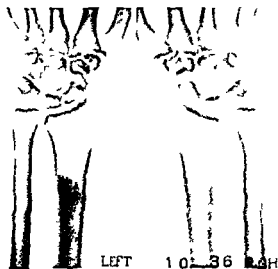


Fig 10 Case 6 R F aged 23 years Roentgenograms taken 7 years 10 months after resection of the right radial head. The radius is short at the wrist. Patient has disabling symptoms at wrist and elbow.

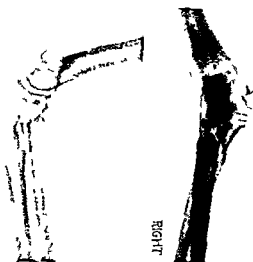


Fig 9 Same patient as shown in Figure 8

motion in the elbow and has no complaints about the wrist. Examination of the elbow revealed normal flexion, extension and pronation. There is moderate limitation of supination, moderate shortening of the radius at the wrist was visible on inspection. The lower end of the ulna did not look prominent. There was slight radial deviation of the hand. Roentgenograms showed moderate shortening of the right radius at the wrist as compared with the left. Roentgenogram of the elbow shows a small new radial head apparently articulating with a small facet on the lateral side of the coronoid process. The space between the new radial head and the capitellum is a little greater than

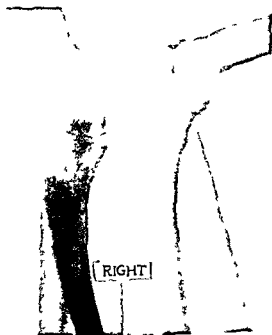


Fig 11 Same patient as shown in Figure 10

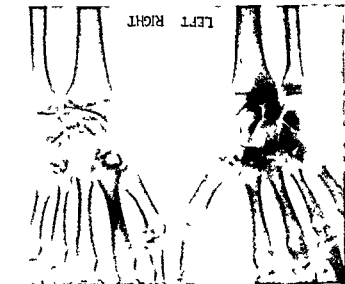


Fig 12 Case 7 A K, aged 14 years. Roentgenograms taken 1 year 9 months after resection of the right radial head. The radius is short at the wrist. No wrist symptoms are noted.

the joint width between the ulna and the humerus (Figs 12 and 13)  
Case 8 E Del C, No H20-213, male, aged 30 years at time of operation. Patient was first seen September 11,

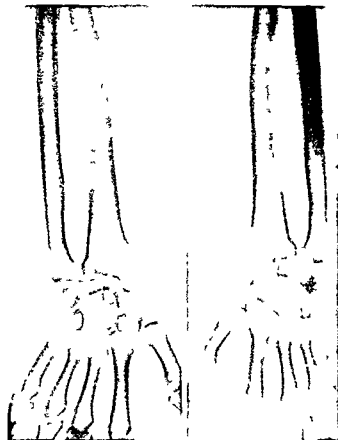


Fig 14 Case 8 E Del C, aged 31 years. Roentgenograms taken 10 months after resection of the left radial head. The radius is not short at the wrist. No wrist symptoms are noted.

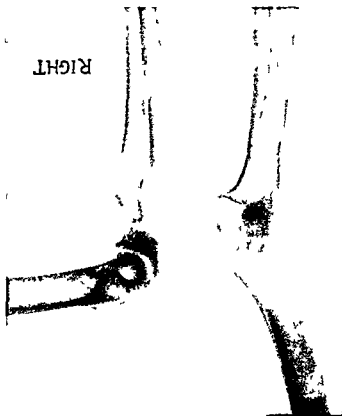


Fig 13 Same patient as shown in Figure 12

1935, when he stated that 5 months previously he fell and fractured the head of the radius and the olecranon process. Fragments of the olecranon process were reduced and fixed with a wire in another hospital. Patient came for treat-

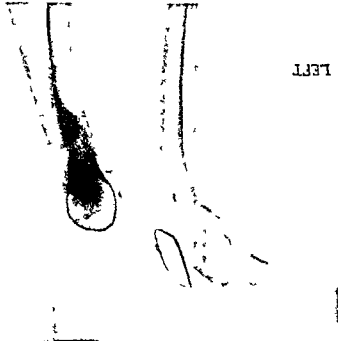


Fig 15 Same patient as shown in Figure 14. Absence of upward displacement of radius is probably due to impingement of the upper end of the radius against the coronoid process.

ment because of a marked limitation of motion in all directions. He was admitted to the hospital September 18 1935. The head of the radius was excised 2 days later. Recovery was uneventful and he was discharged September 30 1935. On November 13 1935 he was seen again and was found to have full rotation 20 degrees of limitation of extension and normal flexion. July 11 1936 examination showed no visible shortening of the radius at the wrist. Elbow showed slight limitation of both pronation and supination. Very slight limitation of flexion and extension. Roentgenograms showed no shortening of the left radius at the wrist. They showed some irregular productive changes at the proximal end of the radius. A small projection on the upper extremity of the radius seems to form a stable articulation with a small flat facet on the lateral side of the coronoid process probably the distal margin of the lesser sigmoid fossa. This appears to prevent upward displacement of the radius (Figs 14 and 15).

Seven of these 8 cases of resected radial heads showed on roentgen examination more or less shortening of the radius at the wrist. In the eighth case (E Del C) impingement of the upper end of the radius against the coronoid process of the ulna is the probable explanation of absence of upward displacement of the radius. On careful physical examination, all the patients except the one showed a degree of deformity varying from slight to marked. This deformity consisted of radial deviation of the hand and prominence of the lower extremity of the ulna somewhat similar to the residual deformity which follows a Colles' fracture which has not been completely reduced.

No significant limitation of motion of the wrist was found, though some did show slight limitation of adduction.

Two of the 8 patients had definite complaints referable to the wrist, one of sufficient severity to prevent his following his occupation as chauffeur. Pain brought the other patient to the hospital for a period of treatment, and was of such severity as to lead to an original incorrect provisional diagnosis of acute osteomyelitis.

#### THEORIES AS TO THE MECHANISM OF THE UPWARD DISPLACEMENT OF THE RADIUS

Factors which would seem of importance in producing this deformity are the following: removal of bony support for the radius at the elbow; loss of the support of the orbicular ligament; stretching of the interosseous membrane and lower radio-ulnar ligaments; upward pull of such muscles as the biceps, brachioradialis, and extensor carpi radialis longior and brevior; and loss of the growth center at the upper end of the radius.

That this last is not of major importance is indicated by the fact that 2 of our patients who showed shortening were beyond the age where growth would be a factor.

The determining factor in limiting the upward movement of the radius we have not determined with certainty. In some cases the radius appeared to be stopped by impingement against the capitellum, and in others by impingement against the coronoid process of the ulna. Still others did not present evidence of bony impingement, which might mean that the maximum deformity had not yet been reached, or that the limit of elasticity of the soft tissues had been reached.

Although some of our cases showed a certain amount of new bone formation about the proximal end of the radius after resection of the head, none showed any such degree of regrowth as described by Suto. Suto makes no mention in his cases of bony relations at the wrist. In view of the findings in our small group of cases, it would seem possible that some of the filling in at the elbow in Suto's might be due to upward displacement of the radius as well as to regeneration of bone. Judging from the roentgenograms alone, such a possibility would seem especially likely in his Case 5.

#### SUGGESTIONS RESULTING FROM THIS STUDY

This series is much too small to warrant any final conclusions. It does suggest, however, that the decision to resect the radial head should not be made casually, and with no thought of conditions except those at the elbow. Consideration should be given to the probability that a certain amount of deformity of the wrist will result from this procedure possibly sufficiently great to distress the patient. And there should be realization of the possibility of subsequent development of troublesome wrist symptoms.

Limiting the amount of excised bone to a minimum might be helpful in avoiding or limiting wrist deformity. Whether, in order to prevent upward displacement of the radius, it would be possible or practicable to create at the time of operation a new joint between the radial stump and coronoid process, such as appears to have formed spontaneously in a few of these cases, we are not in a position to say.

#### SUMMARY

Shortening of the radius at the wrist followed resection of the radial head in seven out of eight patients.

The extent of the deformity which was visible at the time of physical examination varied from slight to marked.

The deformity was somewhat similar to the residual deformity of an incompletely reduced Colles' fracture.

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## ECONOMIC ADVANTAGES OF EARLY PROTECTED WEIGHT-BEARING IN FRACTURES OF LEG, FOOT, AND ANKLE

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The employers of domestic servants can be informed that it will not be necessary for the housemaid or cook to remain off work for many days because of a fractured ankle or a broken foot. In consequence, employment of such domestic servants is maintained and the routine of the home often materially assisted. Pupils and students at schools and universities need lose but little time and are able to carry on without finding life unduly irksome.

Although, hitherto, I have not found it possible to arrange for the return to duty of more than an occasional individual coming under the control of the Workmen's Compensation Commission, the fact that the total temporary disability period of the group of fractures under consideration in this contribution is very expensive to both commissions and workmen will, I believe, result in reconsideration on the part of commission boards which will make it possible for many men to continue at work during the, sometimes, prolonged period required for consolidation and complete return of unimpeded function to take place. For such a condition of affairs to be brought about, considerable more co-operation between employers, commission boards or insurance companies, practicing surgeons and workmen will be required than at present exists in most districts. Prior to the establishment of a Board to handle cases of injury among workmen in the Province of Quebec in 1928, it had been possible for me to arrange for the return to duty of a reasonably large number of cases in which compensation was the responsibility of either employer or insurance company. It is my hope that ere long not only will it be possible to obtain the co-operation here indicated but it may be that three of the interested parties—company, and workman—will demand the serv-

Two of the eight patients had disabling symptoms referable to the wrist. Theories as to the mechanism of the upward displacement of the radius are mentioned. Suggestions resulting from this study are submitted.

IN PREVIOUS communications I have indicated certain upward complications and sequelae which occur following fractures below the knee, and which are avoided in protected weight-bearing. The important unfavorable conditions thus influenced are

- 1 Delayed or—in unusual cases—non-union
- 2 Prolongation or permanence of interference with joint function
- 3 Contractures and consequent interference with the action of muscles and tendons
- 4 Circulatory disturbance, manifested by swelling and loss of tolerance to low temperatures
- 5 Pain upon weight bearing due to decalcification of bone and ligamentous structures—phenomena which when excessively marked have been discussed under the heading "Post-Traumatic Acute Bone Atrophy."

The economic advantages referred to in my title are not primarily meant to indicate the better end results or the shorter period which need elapse between receipt of injury and recovery of function following consolidation of fracture. It is my purpose to show that by the employment of the author's technique much time may be saved during the early stages of treatment, and that resumption of approximately normal activity by many patients may be undertaken before bony union has, in fact, commenced.

In private practice early return to substantially full activity on the part of professional and business men is, as a rule, very much appreciated. Clerical workers and, more particularly, business executives are able to attend their offices and to carry on a usual day's work without difficulty. The same applies to housewives, including the usual necessary duties in the home, not excluding

ices of a surgeon competent to apply an apparatus which will make it possible for many, or perhaps most, injured working men and women to return to duty safely and usefully during the period required for consolidation of fractures of bones of the lower extremities, at least below the knee.

Those surgeons who have had experience in the treatment of fractures by any method which permits early weight bearing will agree I believe that the end results so obtained are better and are reached more quickly than by the traditional method of reduction, application of a padded cast, and either bed rest or a dangling limb with crutches.

I have previously published a somewhat critical review of the advantages and disadvantages of the three more generally employed methods of treating such fractures and which at the same time allow the patient to walk without the help of crutches. The three methods so considered were those of Deibet Boehler and my own. Briefly the objection to Deibet's method is that the support given to the injured limb is usually not adequate and swelling is permitted to take place. In consequence patients so treated are unwilling to bear their whole weight upon the injured limb and furthermore injury to the tissues in consequence of the edema which ensues is all too frequent.

The objections to Boehler's technique are that the plaster, as applied by him is badly depending as it does primarily upon a posterior molded piece for its strength and more particularly, because the steel stirrup which he employs although it is adequate in so far as the protection of the plaster is concerned is not easy to walk on and prohibits the wearing of a proper boot. Since I believe that early return to work by such employment professional clerical or manual depends in large measure upon adequate protection of the, not very durable plaster-of-Paris appliance and also upon its relative inconspicuousness I am convinced that my own method has definite advantages over that of Boehler.

Although publication of the author's method was delayed until 1928 the method of early protected weight bearing employing substantially the method recommended at present has been used in several hundreds of cases since 1919.

The author is of the opinion that, granted adequate reduction has been obtained the group of unfavorable developments tabulated in the first paragraph of this paper may be avoided, or at least their incidence and severity lowered, by a method which permits early weight bearing.

*Delayed union* Among the methods suggested and employed to stimulate bone union in cases in which this process has been delayed or appears not to be taking place, that of Owen Thomas, as popularized by Sir Robert Jones, of exposing and hammering the bone ends, has proved itself to be of real merit. By means of protected weight-bearing in the manner recommended in this contribution, a compromise on this technique is obtained, in that, although the broken bones are subjected to but little strain, nevertheless, the site of fracture is kept constantly irritated with, in consequence, stimulation of an adequate blood supply and apparently also, of osteogenic function.

A recent article of Kuentscher abstracted in the August number of *International Surgical Digest* upon the influence of traction and pressure on the healing of fractures, has been of very considerable interest. Kuentscher's argument, based upon experiments by himself and others, is that if callus is under the influence of traction pseudarthrosis is the result if it is under the influence of pressure, bony union may be expected. Kompecher he says performed experiments whereby by means of wires through the fracture ends he produced at will fibrous or bony union. By pulling the fragments asunder—fibrous union, by pressing them together—bony union results.

*Joint function* Interference with joint function in consequence of prolonged rest of the member is, in part at least, due to atrophic changes dependent upon alteration in blood circulation which are apparently due to influences brought to bear through the nervous system, presumably through the reflex arc. When the patient suffering from a fracture of one or more bones below the knee continues modified weight-bearing upon the limb, approximately normal afferent stimuli from the joint surfaces are induced. In addition also the circulatory efficiency under these conditions inhibits the atrophic changes in, and about, the joints. It will require but few experiments to convince the doubter that movements of the knee, ankle, and foot joints are re-established to a practically normal degree in a very much shorter time in cases in which patients have been ambulant, with weight bearing, than in similar cases in which patients have been either confined to bed, or have walked with crutches, without functioning of the injured limb.

*Muscle function* Although a properly applied circular cast so fixes the joints of the limb that practically no movement takes place, such interference does not prevent contraction and sliding of the muscles and, to a lesser degree, of the ten-







Fig 1



Fig 2

Fig 1 left I roperly applied plaster with felt heel attached which has been worn for 10 weeks with the patient walking without crutch or stick. Note the anterior upper border pressing upon the lower border of the patella and also the covering of the fourth and fifth toes

Fig 2 I laster partially applied in a case of fracture of both bones of the leg. Note stirrup of plaster which reinforces heel, ankle joint region and site of fracture



Fig 3



Fig 4



Fig 5

Fig 3 Custom made boot designed to go over plaster. Note that lacing extends down to the toe

Fig 4 Custom made boot designed to go over plaster. Such a boot is recommended for women who are in a position to afford such an appliance

Fig 5 Custom made boot which has been designed to go over plaster. Note that the lacing in this boot is carried up the back. This type of boot is especially recommended for use by men who must engage in heavy manual labor

cases of fracture of the foot and ankle has been carried up so as to fit the lower border of the patella, in front. The posterior border of the upper end of the cast is cut away sufficiently to permit flexion of the knee to a right angle. The author has made it a practice to include the fifth and, usually, the fourth toes in the plaster, as painted pressure points are thus more surely provided.

In the application of the plaster cast the fact that the weight of the patient is to be carried from the heel of the plaster to the upper border of the tibia is borne in mind, and special care is taken to provide sufficient strength in order that this may be carried out. In my experience, the weak points of the plaster are the lower surface of the heel, across the anterior border of the ankle joint, and about the junction of the middle and lower thirds of the leg. These parts may all be strengthened by a loop of plaster carried around the heel to about the middle of the leg (Fig. 1).

As soon as the plaster of Paris is dry, that is usually the day following its application, a sad sufferer's felt heel, 1 or 1½ inches in thickness is fixed to the sole of the cast by means of adhesive plaster. We have employed the latter method of incorporating the felt under a few thicknesses of plaster at the time of the original application but are of the opinion that, although a neater job is obtained in this way, the technique recommended is the better.

The patient commences walking at once, preferably without the help of either crutch or stick. The length of time during which the walking plaster is worn will depend upon the severity of the original injury, and the bones involved. Since the patient is able to move about early, and since walking is a pure unaided activity, there is no objection to the foot being brought to a position of a right angle with the leg, an unpadding plaster of Paris cast is applied over a silk stocking. This cast reaches from the junction of the middle and upper thirds of the thigh down to the toes, and includes the fourth and fifth toes. The heel is fixed in full extension, and the ankle joint at a right angle. The mid foot is flexed so as to re-establish the longitudinal arch. As in the case of fractures of the ankle, special care is taken to reinforce the bottom of the heel, the ankle joint, and the tibia, to cover all five toes and may well be made to cover all five toes and reach to the upper border of the tibia. The author feels convinced that, although this method of treatment may at first appear cumbersome for limited function, following removal of the plaster.

In the treatment of fractures of the metatarsal bones and of the great toe, a similar technique is employed. Unless deformity is such that some special form of cast is indicated, after a sufficient period of rest to permit swelling to subside, an unpadded plaster which in this case is made to cover all five toes and may well be made to cover all five toes and reach to the upper border of the tibia, is applied. The author feels convinced that, although this method of treatment may at first appear cumbersome for limited function, following removal of the plaster.

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made it a practice to remove the long plaster, immobilizing as it does knee, ankle, and foot joints, and to replace it by a protective dressing, by a Delbet plaster, or by one of the type used for ankle joint fractures

*Custom made boots* The author is of the opinion that the chief advantage of his method as compared with that of Boehler is the comparative ease with which a boot may be made to go over the plaster. Such boots may be so fashioned that they are not particularly noticeable and, in any event, can be made to look neat so that the patient, whether man or woman, is able to go about his, or her, affairs without being unduly conspicuous and, consequently, without embarrassment

It is obvious that the plaster encased foot cannot be put into an ordinary boot, the absence of foot movements and ankle joint movement makes it necessary that the boot be so made that the foot may be laid in it. Two methods have been employed to make this possible. In one, the boot is so made that it laces down close to the toe cap. If the lacing is undone, it is a simple matter to lay the foot in the boot and then to lace it up in the usual way. This makes the foot covering neat and secure. The other method is to make the fore part of the boot of solid leather and to have it lace up the back. In this type, the foot is pushed into the boot from behind, and the lacing then completed.

Four separate types of footwear have been designed. These have been made for the individual patient, in part depending upon the type of activity which is to be engaged in, and in part upon the financial resources of the individual. In the usual type, such as is worn by business executives and professional men, a boot similar to that illustrated in Figure 3 is made by a custom bootmaker. Such boots can be made both with, and without, a heel. If the heel is attached to the under surface of the boot, no felt heel is attached to the plaster. In general, the statement may be made that it is more satisfactory, as a rule, to attach a felt heel to the plaster and to have the boot made without a heel.

The second type has been worn by women and is illustrated in Figure 4. This is not, of course, inconspicuous but is neat and is worn by business women and others without embarrassment.

The third type has been most suitable for those who wish to engage in heavy occupations. As shown in the illustration (Fig. 5) it is made of heavier leather and, the fact that it is not weakened by lacing down the front, makes it more durable.

The fourth type is in the nature of a slipper and has the advantage of being much less expensive than the other varieties, it is laced up the back.

In Montreal, the cost of custom made boots, other than the high boot for women, is between ten and twelve dollars. The slipper like covering can be made for from one to two dollars. Patients for whom funds are not available purchase a simple foot covering—a large moccasin or felt slipper. It is inadvisable to permit the patient to wear a rubber covering since the moisture is likely to soften the plaster.

#### SUMMARY AND CONCLUSIONS

Since the Autumn of 1918, the author has employed the method recommended in this and previous contributions, as a routine, in the treatment of (1) fractures of both bones of the leg, exclusive of those involving the knee joint, (2) all fractures of the ankle joint and (3) all fractures of the tarsus and metatarsus, as well as (4) fractures of the great toe and, occasionally, of the smaller toes. Many hundreds of fractures have been treated by this technique. I have had no occasion to regret the use of the procedure in any one case, and in a number of patients who had not been progressing favorably, improvement has been noted soon after the application of the walking plaster. One case only of non union has occurred and but one of acute bone atrophy.

Table I shows the usual time, following injury, that patients are able to commence walking with out crutches or cane, with protected weight bearing upon the injured limb.

TABLE I—NUMBER OF DAYS FOLLOWING INJURY BEFORE PATIENT MAY RETURN TO WORK

	Days
Both bones of leg	21-28
Ankle joint—seen immediately following injury (before swelling)	1-3
Ankle joint—seen after swelling has taken place—interval in pillow splint	5-8
Os calcis—(reduction by hammering usually 3rd-8th day)	10-16
Astragalus—(astragalectomy for crush fractures)	5-16
Mid tarsal row—(cuneiforms, cuboid and scaphoid)	5-8
Tarsal bones	2-8
Great toe	1-8

It is unusual to find patients who are unwilling to co-operate. Nevertheless, it is frequently the case that a certain amount of education is required to induce the patient to commence weight bearing. Among private patients objections are almost unknown and, the fact that business or professional men, or women, are able

forms the basis of both Boehler's method and my own. The steel stirrup employed by Boehler does not permit a boot to be worn, nor does it, I believe, protect the plaster more efficiently than the felt heel. Patients who have worn both appliances are unanimously in favor of the felt heel.

Apart, therefore, from the fact that it is our belief that earlier union occurs and, consequently, a shorter period need elapse before it is possible for the victim of a fracture to resume full duty with, we fully believe, a more perfect return of function, it is a matter of real importance that many citizens may be permitted, may urged, to return to substantially full duty within but a few days of receipt of a fracture of ankle or foot, and within less than a month in the case of fractures of both bones of the leg.

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to return to their offices without crutch or stick within 3 to 5 days of injury of foot or ankle, is usually greatly appreciated.

If a satisfactory brand of plaster of Paris be employed and the application of the plaster be carried out in accordance with the method advocated in this contribution, the apparatus is moderately durable. The length of time which it will last is dependent, of course, upon the weight of the individual, and the amount of walking he does. As a general rule, it is possible to apply a plaster which will be useful for from 6 to 12 weeks.

The chief objection to the technique recommended in this paper is that, with few exceptions the patient must be admitted to hospital, or be so located that treatment can be carried out in his, or her, own home. Except for the occasional case which is seen prior to the development of swelling, bed rest, with suitable support and posture, must be available for a few days until all interstitial fluid in the affected limb has been dissipated. The absolute necessity of refraining from the application of unpadded plaster until all swelling has disappeared cannot be too strongly stressed. At this time, too, it may again be urged that weight-bearing should not be attempted upon a fractured limb encased in plaster applied over even a thin layer of padding.

It will be noted that there are but minor differences in the technique employed by Boehler and the author's method. As a matter of fact, except for the fact that padding beneath the foot has been eliminated by both, Dollinger's method

# EDITORIALS

## SURGERY Gynecology and Obstetrics

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JUNE 1937

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### THE IMPORTANCE OF EARLY AND ACCURATE DIAGNOSIS IN OSTEOGENIC SARCOMA

OUR knowledge of osteogenic sarcoma and of its treatment has been so materially advanced by the Registry of Bone Sarcoma of the American College of Surgeons that we are now in a position to realize that early and adequate removal of the primary tumor offers the patient his only hope of survival. Generally speaking treatment by radiation unaccompanied by amputation has not resulted in cure. All the 5 year survivals are patients who have been treated by amputation or resection or by amputation supplemented by radiation or by Coley's fluid. In the present state of our knowledge there is good ground for believing that radical removal of the primary tumor before metastases have occurred is the only practical means of curing the disease.

In order to be effective the removal of the tumor must be adequately radical. Since the

majority of such tumors occur in the long bones of the extremities, this usually means disarticulation of the limb at the joint above the level of the tumor. Such treatment is sufficiently mutilating to arouse the greatest repugnance in the minds both of the surgeon and the patient or his parents, especially since the majority of the victims of this disease are adolescents or young adults. If this be the only effective form of treatment we must be sure of our ground lest our natural aversion to such mutilation lead to temporizing measures which deprive the patient of his only hope of survival. Fortunately, the facts to be learned from the Registry of Bone Sarcoma are definite and admit of only one interpretation: radiation, or any other treatment short of amputation offers only the remotest chance of cure; amputation, if successfully undertaken before metastases have occurred, can cure the disease. Though it is true that even after amputation the percentage of 5 year survivals is small (14 per cent), there is hope that more clear recognition of the radical nature of successful treatment will lead to earlier treatment which will be adequately radical and that this will be followed by a higher percentage of cures. The necessity of radical treatment as the only reasonably hopeful measure should be emphasized in order that there be no time lost in temporizing through more humane treatment.

To be successful even radical disarticulations must be undertaken early. The primary lesions must be removed before pulmonary metastases have occurred and since these occur early in the disease, amputation at the earliest moment is the only treatment which has any hope of success. This necessity places great

1061

## EDITIONS

[illegible]

primary growth before metastases have occurred. This statement requires bold emphasis and sincere recognition. Even this radical treatment is dependent upon early and accurate recognition of the tumor if it is to have any hope of success. In this connection biopsies are of great value. The danger of biopsy, if any exists, can be made a minimum by isolating the field with a tourniquet and planning the procedure so that amputation can be done under the same anesthetic if the pathologist confirms the clinical diagnosis. R I HARRIS

### SOME OBSERVATIONS ON ORTHOPEDIC SURGERY IN EUROPE

A FAIRLY extensive trip over Europe, with a glimpse into orthopedic clinics here and there, cannot but convince one that this specialty at least is growing steadily and becoming more and more important in most of the European countries.

With the meeting of the International Society of Orthopedic Surgery in Bologna a very good introduction to such a clinical tour was gained. The choice of Bologna was particularly fortunate, as it is the site of the Institute Rizzoli, one of the most complete orthopedic institutions in the world. Here, many developments of great importance in orthopedic surgery have been evolved since its establishment over one hundred years ago, and many orthopedic surgeons from all parts of the world have received instruction and stimulation from visits there. The presence of Professor Putti as president of the Congress added much to its success. He is one of the world leaders in orthopedic surgery and one of the founders of the International Orthopedic Society; he is an able surgeon and a man of great personal charm, the entire meeting centered around his presence and leadership.

Whether because of Putti's commanding influence or not, one could not help but gain the impression that orthopedic surgery in Italy has enjoyed very great progress. Those Italians who were on the program all had something of interest to say and were enthusiastic about their work. An outstanding example of this was found in a presentation by Faldini of Milan of an operative procedure for the treatment of fresh fractures of the neck of the femur. He proposed immediate osteotomy below the trochanter, with fixation of the hip operated upon in right-angled abduction for a period of several weeks. Proof of the efficacy of this treatment was furnished when he presented ten elderly women who had all been treated in this manner and who had all obtained excellent results. A high standard of excellence for papers before an international society was set by the author who presented his paper briefly in Italian, and then in English, French, and German.

In Professor Putti's inaugural address he pointed out that orthopedic surgery had long been regarded in Italy as the "surgery of the organs of movement." As such, Putti believed that the care of most traumatic conditions should come under the orthopedist's supervision. To this end the International Society of Orthopedic Surgery changed its name to the "International Society of Orthopedic Surgery and Traumatology."

Three distinct trends in the type of hospital organization for the care of orthopedic cases may be noted in the British Isles and in Continental Europe. First there are the old established general hospitals with orthopedic services. In some places the general surgeons have shown great reluctance to allow establishment of these services, but in the more progressive centers, such services have been built up and have reached a point of efficiency which insures their permanency. Many have



taken over at least in part the treatment of fractures, and such a division for the care of same type of organization may be found in Denmark, and a new hospital of this type is in operation in Copenhagen. There were similar hospitals in Sweden and Czechoslovakia. Most of these hospitals are very complete units so far as care of the crippled is concerned. They not only have complete hospital units, with all the necessary operating rooms and physiotherapy equipment, including in many instances pools for the treatment of patients with infantile paralysis, but also schools, often vocational as well as grammar, and complete brace shops and factories for making artificial limbs. Such complete units can be found in nearly all of the countries of Europe.

The third type of hospital is best exemplified in the clinic of Professor Boehler in Vienna which is a hospital built by an insurance company or several insurance companies for the handling of insurance cases. Because of the excellence of Boehler's work and the worldwide reputation he has established in the care of fractures, it is only natural that others should attempt to follow his example in every detail, and there are accordingly other hospitals like his which are well run and well organized. How far such institutions might go in a country as large as ours is difficult to guess.

Thus there are in Europe today three different trends in the manner of handling orthopedic cases. Each type of institution, when backed by an efficient and progressive staff, is doing excellent work, and it would be difficult to say which type might assume greater leadership in the development of orthopedic surgery during the next fifty years.

RALPH K. GHORMLEY

paying for their hospital care by county and state funds, the organizations themselves run

private philanthropic societies and committees. While many patients are aided in England and this work has been carried on by orthopedic patients for the many years that they insure an almost constant contact with both as to medical and social services and necessary. These clinics are well organized patients along in their after-care so long as subsidiary clinics which look after the collection of cases for the hospitals and follow the themselves is the organization of central and orthopedic as well as nursing. What is perhaps more important than the hospitals orthopedic as well as competent staffs, who are well cared for by competent staffs, orthopedic patients, both adults and children, In these hospitals may be found all sorts of the late Sir Robert Jones, many such centers have been established in the British Isles as a result of the impetus given this work by adults with orthopedic conditions. Largely devoted to the care of both children and adult, is the orthopedic hospital which is England and Scotland, as well as on the Continent, is the second type of hospital to be seen in the second type of hospital to be seen in the development of schools of physical therapy.

- cervical dislocation. Manipulation of fracture dislocations of vertebrae associated with spinal cord injuries 407 Fracture of hip joint, treatment by extra articular fixation with adjustable nails 420 Young, S. Radical cure of cancer of prostate 472 Boehler, I. Fractures of os calcis 663 Agnew, S. Modified operation for syn-dactylism 793 Hibbs, Albee Spinal fixation ultimate results in 4 cases with Pott's disease, vented at secondary operation 826
- Microscope, Surgeon's interest in new world ed 966
- Montreal General Hospital. Cancer clinic in general hospital with public and private patients 490
- Mortality. Survey of appendicitis in San Diego 239 Shock ed 245 Changing of urologic surgery, ed 247 in surgical diabetes—criteria and technique in extremity lesions 5 year study of 406 cases 956
- Mortality statistics. Mortality rate of appendicitis ed 836
- Moulmier, Father C. B. tribute. Medical practice and law—some parallel relationships and problems 576
- Mouth. Pathological conditions affecting salivary glands and floor of 517
- Mucosa gastric. Prolapse of through pylorus surgical treatment 609 cervical. The physiology of the human 153
- Muscle quadriceps. Complete dislocations of knee joint report of 7 cases with end results 94
- Myocardium. Coronary sclerosis and angina pectoris treatment by grafting new blood supply upon myocardium 210
- N**ATURAL bones. Fractures of jaws and treatment 69 Treatment of old traumatic bony lesions of face 376
- Neoplasms melanotic. Clinical considerations of eye and orbit 513
- Nerve peripheral. Tumors of hand 129 cardiac. Mechanism of relief of pain immediately after total thyroidectomy for angina pectoris and congestive failure 165 auditory. Fetal. Maturation and its relation to fetal ear 342 peripheral. Differentiation between peripheral arterial and arteriovenous spasticity as aid in selection of cases for sympathectomy and sympathectomy 1015
- Neuritis. Scalenus syndrome ed 119
- Nose saddle. Multiple stage operation for difficult avoidance of scar 102 Early local care of face injuries 318, Traumatic deformities of and other bones of face 332 Neglected and recurrent basal cell epitheliomas of face 613
- O**BSTETRICS. Study of placenta accreta 118 More conservatism in cesarean section 318 Pelvic variations in 300 primiparous white women clinical study and proposed classification 700 Viscer-Bowman chemical test for pregnancy and urinary pigment 806 Intussusception during pregnancy 811 Phenomenon of lightning in pregnancy and lower uterine segment 906
- Occupational diseases of eye. Occupational study of cancer of eye and adnexa 418
- Olecranon. Common fractures about elbow joint in children 447 Fractures of patella 1074
- Omentum. Lymphatics in omental adhesions 872
- Operations. Wertheim's hysterectomy. Radium versus in treatment of carcinoma of cervix 332 Stabilizing of foot. Arthrodesis of foot in infantile paralysis 194
- Orbit. Clinical considerations of melanotic neoplasms of eye and 513
- Orthopedic surgery. Some observations on in Europe ed 1094
- Orthoptic training. Surgical results in 224 cases of heterotropia especial reference to 336
- Os calcis. Fractures of bones of foot—except 434 Fractures of, 663
- Os trigonum. Fractures of bones of foot—except os calcis 454
- Osteomyelitis of bones of hand, 1
- Osteoporosis. Carbohydrate metabolism disturbance in and Paget's disease associated soft tissue disturbances and results of various therapeutic procedures 747
- Out patient department, Undergraduate teaching of surgery ed 711
- Ovary. Physiology of human cervical mucosa 758 Endocrine therapy in gynecology ed 833 Hydatidiform mole and chorionepithelioma 5 year study, 1021
- P**AIN. Mechanism of relief of immediately after total thyroidectomy for angina pectoris and congestive failure 165
- Pancreas. Cure of pancreatic fistula by pancreatojejunostomy report of case with review of literature 19
- Paralysis infantile. Arthrodesis of foot in 794
- Paré, Ambrose op 1
- Parotid gland. Pathological conditions affecting salivary glands and floor of mouth 517
- Pasteur. Surgeon's interest in new world ed 966
- Patella. Complete dislocations of knee joint, report of 7 cases with end results 94 Arthroplasty in ankylosis of knee by interposition of patellar flaps, 673, Fractures of 1014
- Patients private. Extension of tumor clinic service to include 497 ward and private. Cancer clinic in general hospital with 419
- Pelvis. Pelvic variations in 300 primiparous white women clinical study and proposed classification 700 Contraction 5 year survey of cesarean sections at William II Coleman Hospital 1035
- Pentothal sodium for intravenous anesthesia 888
- Peptic ulcer. Acute perforation of evaluation of contributory and exciting causes 863
- Perforation. Acute, of peptic ulcer evaluation of contributory and exciting causes 863
- Peritoneoscopy. Differential diagnosis of ectopic gestation by 229
- Peritonitis. Chronic intestinal obstruction due to lesions of large bowel 81
- Phalanges. Osteomyelitis of bones of hand 1, Small bone repair 9
- Physick, Philip Syng 718
- Physiology of human cervical mucosa 758 Observations on human being following colectomy or colonic excision with ileostomy 349 Certain chemical factors in experimental high intestinal obstruction 802
- Pigment urinary. Viscer-Bowman chemical test for pregnancy and urinary pigment 806
- Pitressin (beta hypopharyne) in laparotomies 905
- Pituitary gland extract. Pitressin (beta hypopharyne) in laparotomies 895
- Placenta accreta. Study of 178
- Placenta praevia. 8 year survey of cesarean sections at William II Coleman Hospital 1035
- Plastic surgery. Traumatic deformities of nose and other bones of face 532
- Pneumocystography. Diagnosis and treatment of tumors of bladder by means of roentgen rays 980
- Pneumolysis. Principles of 820
- Pneumonecrosis. Surgical treatment of carcinoma of lung technique of lobectomy and, 99
- Porcelain. Injuries of hands due to shattered handles of water faucets 930
- Pregnancy. Cardiac asthma and acute pulmonary edema complications of non-convulsive toxemia of 39

taken over at least in part the treatment of fractures, and such a division for the care of all concerned. With this development of orthopedic services in general hospitals has gone a parallel development in out-patient services, including the establishment of physiotherapy departments which are more or less extensive in scope. In some instances these departments have reached a high standard of efficiency, not only in the treatment of patients, but in the development of schools of physical therapy.

The second type of hospital to be seen in England and Scotland, as well as on the Continent, is the orthopedic hospital which is devoted to the care of both children and adults with orthopedic conditions. Largely as a result of the impetus given this work by the late Sir Robert Jones, many such centers have been established in the British Isles. In these hospitals may be found all sorts of orthopedic patients, both adults and children, who are well cared for by competent staffs, orthopedic as well as nursing. What is perhaps more important than the hospitals themselves is the organization of central and subsidiary clinics which look after the collection of cases for the hospitals and follow the patients along in their after-care so long as necessary. These clinics are well organized both as to medical and social services and they insure an almost constant contact with orthopedic patients for the many years that are necessary for their adequate care. In England this work has been carried on by private philanthropic societies and committees. While many patients are aided in paying for their hospital care by county and state funds, the organizations themselves run

The third type of hospital is best exemplified in the clinic of Professor Boehler in Vienna which is a hospital built by an insurance company or several insurance companies for the handling of insurance cases. Because of the excellence of Boehler's work and the world-wide reputation he has established in the care of fractures, it is only natural that others should attempt to follow his example in every detail, and there are accordingly other hospitals like his which are well run and well organized. How far such institutions might go in a country as large as ours is difficult to guess.

Thus there are in Europe today three different trends in the manner of handling orthopedic cases. Each type of institution, when backed by an efficient and progressive staff, is doing excellent work, and it would be difficult to say which type might assume greater leadership in the development of orthopedic surgery during the next fifty years.

RALPH K. GROSSMAY

# MASTER SURGEONS OF AMERICA

## RUSSELL A HIBBS

**R**USSELL A HIBBS was one of the outstanding surgeons of his era and his contributions to orthopedic surgery mark him as one of the foremost in that specialty since its beginning. Unprejudiced by the generally accepted views and practices of his time, he slowly and carefully formed his own opinions from personal observations and, once having made up his mind that he was right, he persevered in that course in spite of all opposition until he finally convinced his critics. This attitude combined with a great originality and ingenuity in devising new operations and methods of treatment, made his influence, more than that of any other, responsible for transforming orthopedics into a real part of surgery during the last thirty years.

Although he wrote on almost all subjects pertaining to his specialty, his most conspicuous work was on joint tuberculosis and it was this which first gave him a world wide reputation. His efforts have effected a complete revolution in the treatment of this condition and have made it possible by surgery to effect a rapid cure and to save its victims from a life of invalidism. Early in his career he realized that the results obtained by the generally accepted methods of treatment were unsatisfactory. He decided that this was due to lack of fresh air and sunlight and the poor surroundings in which the majority of the dispensary patients lived. His appeal for something better resulted in building a country branch for the New York Orthopaedic Dispensary and Hospital, of which he was the surgeon in chief. The building of this institution had an important influence in making him seek other means for curing the disease, for it proved to him that even under the best obtainable conditions the conservative measures, such as the application of braces and the use of heliotherapy, were a failure.

Dr Hibbs' observation that the only cases of tuberculosis of the spine that really were cured by conservative treatment were those in which a natural fusion was secured led him in 1911 to devise the spine fusion operation, perhaps his greatest single achievement. At first it consisted simply in breaking down the spinous processes and causing them to grow together, but soon the technique was perfected and included the fusion of the lamina and lateral articulations as well. Not only was it a brilliant success in the treatment of Pott's disease but its application to lateral curvature, fractures and various anomalies of the spine has changed entirely the treatment of those conditions. The development after many painstaking efforts of a successful method for the correction of scoliosis,

RUSSELL A HIRBS  
1869-1932





and the maintenance of that correction by the fusion operation constitute another brilliant chapter to which he contributed in the history of orthopedic surgery.

In 1909 Dr Hibbs devised an operation for stiffening the knee joint which could be used for children without interfering with the growth of the extremity. It originally was intended for stabilizing flail joints in cases of poliomyelitis and is used extensively for that purpose. It soon was used also as a means of curing tuberculosis of the knee, and has done the same thing for that lesion that the spine fusion operation has done for Pott's disease. An operation for arthrodesis of the ankle followed.

It was generally conceded that of all tuberculous joints the hip was the most serious and that the results were universally bad. Although it was realized that the same principles applied here as in the other joints and that fusion would solve the difficulty, a method for accomplishing this was sought in vain. Finally, in 1926 Dr Hibbs invented the operation of transplanting the greater trochanter and using it as a bridge from the femur to the ilium. This completed a monumental work, for this operation made it possible to cope with tuberculosis of all the joints.

Much of the misunderstanding about joint tuberculosis and the failure of others to comprehend the inadequacy of the older methods in dealing with it, were due to the gross errors in diagnosis which resulted from reliance upon clinical and x-ray examinations. Dr Hibbs insistence upon the use of more exact methods, including exploratory operation and biopsy, demonstrated how widespread the mistakes had been and that many of the cases that had been regarded as cures had not been tuberculosis at all. His careful follow-up studies of his tuberculous patients for long periods of time, and his refusal to accept as a cure any case that had not been thus studied, showed that many of the so called cures had relapsed after several years.

An essay on the management of the proximal fragment in cases of fracture of the upper third of the femoral shaft, which won a prize, and a new operation for lengthening the tendo achillis, both produced early in his career, are other evidences of his originality and resourcefulness.

His many contributions to surgery, almost any one of which would have been sufficient to bring him fame, represent only one phase of his remarkable achievements. His great ability as an organizer and administrator is shown in the development of the New York Orthopaedic Dispensary and Hospital, of which he was made surgeon-in-chief in 1899. At that time it was a small hospital occupying a remodelled dwelling house. Under his direction and as a result of his enthusiasm it has now grown to a large, splendidly equipped institution with a bed capacity of three hundred, including a beautiful country branch at White Plains for the convalescent care of these patients. In 1904 Dr Hibbs founded

the New Jersey Orthopaedic Hospital and for years thereafter was its consulting surgeon and guiding spirit. It is now a finely equipped hospital with an affiliated convalescent home, in which is done the same type of surgery as in the New York Orthopaedic Hospital.

Another of his chief interests was medical education and the development of young men. In 1918 he was appointed professor of orthopedic surgery in the College of Physicians and Surgeons, Columbia University, a post which he held until a few months before his death. His lectures were always among the most popular in the curriculum and caused his students to take a keen interest in the subject. His concern for the better training of young surgeons after they had finished their internship led to the establishment of the Anne C. Kane fellowships at the New York Orthopaedic Hospital. They make provision for the continued training of a selected group of these men at the hospital for several years at an adequate salary. It was Dr. Hibbs' hope that this example might lead to similar fellowships in other fields of medicine and surgery. His greatest delight was in the success and achievements of the young men who had gone through this hospital and the occasion of their return to an annual meeting at the hospital was to him the great event of each year. His devotion to children was further exemplified by his deep interest in Hope Farm, a community home, of which he was president for many years.

To those who knew him best his greatness lay even more in his fine spiritual qualities, in his never failing conviction that the truth must always prevail, in his steadfast adherence to any course that he believed was right, and in that rare gift of leadership which inspired all those who served under him to give the best that was in them and to feel that to work with him was a privilege. He always maintained that any accomplishment that was made in the advancement of medicine must come from a deep sympathy of the doctor for his patient and from his real concern in making him well.

Dr. Hibbs was born in Birdsville, Kentucky, on September 1, 1869. He attended Vanderbilt University and received his medical degree from the University of Louisville in 1890. After practicing for several years as a country doctor in a remote part of Texas, he went to New York in 1893, determined to prepare himself better for his work. He was an interne for one year at the Poly clinic Hospital and then became resident surgeon at the New York Orthopaedic Dispensary and Hospital. When he had served in that capacity for 6 years he was made surgeon in chief in 1899, at the age of 30, and was still in active charge of the hospital at the time of his death, September 16, 1932. He also was consulting surgeon to the Presbyterian, Babies', French Sea View, and Beekman Street Hospitals, the Neurological Institute, the New York Infirmary for Women and Children, and St. John's Riverside Hospital, Yonkers. He was a member of the American Orthopaedic Association, the Interurban Orthopaedic, and Union



Clubs, the Practitioners' Society, and a fellow of the American Medical Association, the American College of Surgeons, and the New York Academy of Medicine. During the World War Dr Hibbs was a major in the Medical Corps of the Army and a consultant at the Walter Reed Hospital.

On September 1, 1904, Doctor Hibbs married Miss Madeline Cutting, who was the daughter of the late Walter Cutting, at Pittsfield, Massachusetts.

ALAN DEE SMITH

Dear Mr Moore -

an Vicararius said of  
O W W. & S W W. we  
are better than old  
"counts in a meadow",  
I give you a letter  
you give me a letter  
Ah - well - I am not  
desperased to have  
you see that an  
older than you  
has pearls -  
forced to be fairly  
dear with

The immense boys of  
vention no - me  
- of - or indiffer  
even can take  
away -  
better - or very  
much, that you  
so like them -

Yrs sincerely

Werr Mitchell

Dr S Moore Esq

A facsimile of a letter from Dr S Werr Mitchell (1830-1914) of Philadelphia, poet and physician whose description of Causalgia remains a classic in medical literature

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

concludes with, "True progress (in rejuvenation) has been retarded by extravagant claims and publicity in the lay press."

The library of any surgeon or urologist is not complete without this fine work. L. L. VESSEN

SINCE the publication of the second edition of Cabot's *Modern Urology*, generally approved and recognized in 1924, there have not only been many changes of thought in the therapeutic and surgical management of various diseases of the genito-urinary tract, but likewise many epoch making additions heretofore never thought of or only lightly touched. Outstanding progress in diagnostic procedures has been made as well as important additions and changes of opinion of etiology.

This third edition has been so thoroughly revised to include the many advances made in this specialty that it is essentially a new work. Obviously many new authors are added and the works of other authors changed in keeping with their special experience and recognized ability at this date.

The thoroughness with which this field is covered is indicated by the fact that it totals 1813 pages, illustrated with 620 engravings and 21 plates. One is impressed by the lack of repetition, the completeness of each subject discussed and the extensiveness of the bibliography. Many chapters are, in fact, monographs and include historical data together with the latest recognized views on the subject. The technique of surgical procedures is discussed in the minutest detail accompanied by step by step illustrations which should be readily understood.

This is a thorough, comprehensive work, modern to the last minute, produced by authors who speak with authority on their particular subjects, which facts make it a valuable asset not only for urologists but for general surgeons, internists, and general practitioners as well. As a reference work for medical students, working on special subjects, it has been found invaluable.

AN EXCELLENT analysis of current thought for and against the use of digitalis in the various problems associated with heart disorders is made by Lutien in his recent monograph. The book is well organized, clearly printed, carefully bound, and points pro and con of many investigators accurately indexed. The author presents the view-  
*Modern Urology* In Original Contributions by American Authors Edited by Hugh Cabot M.D. L.D. C.M.G. F.R.C.S. Vols. 1 and 2  
 Springfield Illinois and Baltimore Maryland Charles C. Thomas  
 1930  
 101

THE revision of the popular volume by Holmes and Kugles brings the subject of roentgen interpretation up to date. The work covers the field of roentgen diagnosis and includes an adequate bibliography at the end of each chapter. The illustrations show for the most part typical lesions and in some instances a replacement of the previous editions by better re-

productions. The 243 engravings are made up largely of excellent reproductions of roentgenograms. The chapter on bone pathology has been completely revised and now includes material dealing with bone changes associated with various degenerative diseases and glandular dysfunction as well as the more rare conditions, such as renal rickets, lead poisoning, Gaucher's disease, and marble bone.

In the chapter on chest the authors have added material on calcification within the heart, Auer's disease, myxodema, Baeck's sarcoma, and psittacosis. A discussion on renal fold studies, hepatorenal sprue, and regional ileitis has been included in the chapter on the gastro intestinal tract. The sections on cholecystography, intravenous urography, renal anomalies, pelvic and fetal measurements have been revised and enlarged.

The subject material is presented in a concise manner but covers the field of roentgen diagnosis adequately. The volume has long since established itself as an excellent textbook for undergraduates and should be very helpful to the medical practitioner. It is recommended without reservation.

EARL E. BARTH

ALL the diseases of the testicle as well as the anomalies are treated by Bailey in his complete monograph. The epididymis and coverings of the testicle are also included. This small compact volume is profusely illustrated and contains several excellent colored plates. The paper is of the best quality, and the book has an unusual cloth cover, seldom seen in standard medical books.

The subject matter is expertly handled, each chapter is concluded with the references applicable to the subject, which makes easy and pleasant reading. Functional diseases and the subject of rejuvenation are briefly and thoroughly handled. Dr. Bailey

ROENTGEN INTERPRETATION A MANUAL FOR STUDENTS AND PRACTITIONERS By George W. Holmes M.D. and Howard E. Kugles M.D. 5th rev. ed. Philadelphia Lea & Febiger 1930  
 DISEASES OF THE TESTICLE By Hamilton Bailey F.R.C.S. (Eng.)  
 London H. B. Lewis & Co. Ltd. 1930

critically analyzes their studies of the value of digitalis

There is an excellent discussion of indications and methods of dosage and the author advises oral administration as most preferable. The toxic effects are carefully discussed and a plea is made that the physician should be equally cautious in observing the patient for the optimum results and toxic manifestations as in choosing his indications.

The pharmacological action of digitalis is discussed in detail. He points out that "the therapeutic efficacy of digitalis results from the action of the drug upon ventricular muscle, and furthermore that 'tachycardia *per se* is not an indication for digitalis. Pneumonia, shock, septicemia, angina pectoris and many toxic states associated with tachycardia are not indications for the use of digitalis.

The text will be of practical value to the practitioner the specialist and the medical student.

CHAUNCEY C MAHER

THE lengthy and detailed volume on urology by Fowsley and Kirwin<sup>1</sup> is unquestionably the best of its kind to date. The reviewer has attempted to teach nurses the rudiments of urological nursing for several years and has felt the lack of a complete work of this kind. There are some good books on this subject but none of them go into the minute detail found here.

The authors give full credit to the entire nursing staff of the department of urology of the (James Buchanan Foundation) New York Hospital.

The volume is profusely illustrated with clear photographs, drawings, charts and cuts of various instruments. The history of urology is briefly given followed by the public health aspect of tuberculosis and venereal diseases. This is followed by the technical procedures peculiar to urology, then the care of instruments which is an important matter as many urologists can testify. A review of embryology accompanies the management of the many diseases and malformations of the genito-urinary tract. Surgical technique is detailed as is also nurses set up and the postoperative care. After an excellent chapter on diets the authors conclude with a comprehensive glossary of urological terms.

It would well profit the interne and resident as well as the urological nurse to study this book for its practical value. The authors have well attained their aim and purpose as expressed in the preface.

L. L. VESEEN

EVERY elaborate clinical and histopathologic study of a large number of cases of Paget's disease and related conditions is the basis for Inglis's monograph<sup>2</sup> entitled *Paget's Disease of the Nipple*.

<sup>1</sup>UROLOGY FOR NURSES. By Oswald Swinney Fowsley, M.D. F.A.C.S. and Thomas Joseph Kirwin, M.D. F.A.C.S. Philadelphia: London: Blotfree J. B. Lippincott Co. 1936.  
<sup>2</sup>OXFORD MEDICAL PUBLICATIONS. PAGET'S DISEASE OF THE NIPPLE AND ITS RELATION TO SKIN CANCERS AND PRECANCEROUS STATES IN GENERAL. By Keith Inglis, M.D. Ch.M. (Sydney). London: Oxford University Press, 1936.

The observations are presented extensively in case reports and are well illustrated by excellent gross pathological and histological photographs. On the basis of this material, the author formulates his opinion in the long controversy concerning the histogenesis and the clinical importance of Paget's disease of the nipple as follows:

He considers Paget's disease as a special variety of cancer of the mammary ducts. It is a surface cancer beginning at the junction of lactiferous duct with epidermis or in a lactiferous duct near its outlet. It is neoplastic from the outset. From its site of origin the growth, without forming any definite nodules, extends by continuous spread downward in the epithelium lining of the duct wall to the acini and outward in the epidermis of the nipple. The duct lesion and the skin lesion represent the same stage in the one pathological process. The disease may remain limited to the epidermis and the ducts for many years, but usually within a few years scirrhous cancer forms in the substance of the breast.

The author discusses separately the clinical and histological picture of Paget's disease caused by this series of pathological changes. He includes Paget's disease uncomplicated by scirrhous carcinoma. Paget's disease complicated by scirrhous carcinoma and Paget's disease in which the presence of scirrhous carcinoma is doubtful.

Following the clinical and histological discussion of these different types of Paget's disease of the nipple the author discusses the histological appearance of conditions which may be confused clinically with Paget's disease as cancerous infiltrations of the nipple by deep seated cancer of the breast or eczema and dermatitis of the nipple or areola simulating Paget's disease.

After a short discussion of other primary diseases of the nipple, as connective tissue and epithelial tumors, he devotes some chapters to lesions of squamous cell epithelial structures which may show changes in the squamous epithelium similar to those observed in the skin epithelium of Paget's disease. He includes here Paget's disease of other parts of the body, Bowen's precancerous dermatoses and precancerous changes in the epithelium of the upper alimentary tract, the vulva, the cervix uteri, and the glans penis. He demonstrates the principal difference in the histologic and histogenetic characteristics of these lesions as compared to Paget's disease of the nipple insofar as all these lesions originate from cancerous changes of the epithelial cells *in situ*, whereas in Paget's disease he considers the cancerous cells as having invaded the epithelium of the overlying skin.

It is obvious from this review that the author is not in agreement with some other authorities in this field, as for instance Cheate<sup>3</sup> regarding the histogenesis and the mode of growth in Paget's disease of the nipple. He does however agree with the more practical consequence in regard to the almost universally accepted opinion that Paget's disease should

This volume represents a most valuable archive of detailed clinical reports and beautiful histologic pictures of Paget's disease and related conditions. The material on the interpretation of the material on which the study is based together with the exhaustive discussion of the literature gives it its proper place in the vast amount of material already available in the much discussed field.

Max Cutler

SLACK CUTLER

THE PREFACE of their book, entitled *Obstetrics: Management and Nursing*, Woodward and Gardiner state clearly their purpose, "First to supply the student with what she should know about obstetrical nursing, second, to add to her general knowledge pertaining to obstetrical management, the part the obstetrician plays and her duties in assisting him in an efficient manner, third, to provide for the needs of the student who would specialize as an obstetric nurse or become a supervisor of obstetrical nursing."

The book contains several helpful and interesting parts, such as the unit on "The Background of Obsterical Nursing," and the chapter on "Mental Hygiene of the Pregnant Woman." The subject naturally falls into certain units and this method of organization is very suitably used here. Each unit is divided into chapters. The units are preceded by a glossary in alphabetical order with the pronunciation

Each chapter contains a brief outline of the material presented. Each part of the chapter has a summary and at the end is given a "Continued Study Unit" that contains further study references, then a list of questions on the subject matter that has been presented in that chapter. One feature of the questions is that some of them are not specifically answered in the text. The last presentation is a "Correlations for Next Chapter."

The chapters on the abnormalities of pregnancy, labor, and the newborn are given after the student has gained a good knowledge of a normal pregnancy and labor. This should be most helpful to the student because in presenting it in this way there should be no confusion of the two. The chapters, illustrations, and drawings throughout the book are numerous and well chosen. The drawing on fetal circulation is particularly good.

The instructor of obstetrical nursing should find this book most useful. It presents the material in a clear, logical, and interesting manner and could be used either as a text or reference book.

LOENA ROBINSON R N

The new textbook of medicine by the well known physician, Jonathan Meigs, of McGill University, differs considerably from the standard textbook by Dr Osler. The subject matter is rearranged and Dr Meigs' views on the treatment of the various diseases are given in a more practical and up-to-date manner than in the standard text. The book is published by the University of Toronto Press, and is available in both English and French editions. The price is \$2.50 per volume, and the total price for the two volumes is \$5.00. The book is available in both English and French editions. The price is \$2.50 per volume, and the total price for the two volumes is \$5.00.

so that the diseases of the upper respiratory tract appear first and in a systematic order Chapter 5 on the "Diseases of the Lungs" is especially well created as might be expected from one who has done so much with the respiratory system as has Dr. Mehlman. The extreme importance of continuous oxygen therapy and caution of respiratory depressants such as morphine in pneumonia is brought out with emphasis. Similar evidence of a truly modern text are shown by the discussion of the basic principles in the section on vascular disease where helium therapy may be applied. Contrary conclusion, though not featured, is discussed in more detail than in similar texts, which the reviewer has always felt is a serious neglect of an important topic. The section on hypertonemia is stated in a concise manner. Electrocardiograms and numerous photomicrographs add materially to this chapter. Diseases of the urinary system have been discussed well at the back of the book, which sections is written by Walter de M. Scurer. The subject matter is well arranged, but not enough space has been allotted to develop the subject adequately. The same criticism may be applied to many topics of this volume, as to all other texts of this type.

A moderate number of good references appear at the end of each chapter. The chief step forward in Dr. Mehlman's book is the large number of colored plates, graphs, and photomicrographs which follow the present trend toward visual education.

THE subject matter of Browne of Dublin's *Manual of Practical Obstetrics* is arranged in the conventional manner. The reviewer kept in mind at all times that this volume was "written in Dublin, and as the author expressed, "it was written specifically for students and the general practitioner," presumably in Ireland. He further explained that "the text is the expression of the experience gained both in actual practice and whilst teaching students and post-graduates."

While the keynote of this manual denotes conservatism in the management of pregnancy and labor, it is apparent that many of the methods used in Dublin are unusual and do not quite meet our ideas of conservative obstetrics. The unconcern with which the problem of occiput posterior positions is treated is such an example. The book might have a place in the American obstetrician's library as a reference, but it can hardly be recommended as a text for general use in this country.

C. C. DONERLY

A NUMBER of well known authors in the field of heart disease contributed to the comprehensive survey of the modern concepts of diseases of the coronary arteries and cardiac pain and the text was

edited by Dr Levy. The book is splendidly printed, well bound, fully indexed and includes an extensive bibliography of both historical and modern references of the subject.

Dr Alfred E. Cohn, in the introduction, rationally outlines the subject matter and discusses many of the current unsolved problems. Dr James B. Herrick follows with an excellent historical note.

The anatomy and physiology of the coronary circulation is discussed by Dr Joseph T. Wearn and Dr Carl J. Wiggers respectively. The latter subject is discussed in considerable technical detail and many controversial issues are fully covered. The effects of the nitrites, theobromine, digitalis, glucose and insulin, epinephrine and pituitrin upon the coronary circulation are briefly discussed by Dr Fred M. Smith. Dr William C. von Glahn covered the histologic findings of the coronary arteries in infectious diseases, periarteritis nodosa, rheumatic fever, syphilis, tuberculosis and arteriosclerosis, but mention is not made of the histologic changes associated with acute occlusion. The nervous pathways and the physiology of the coronary arteries are described by Dr James C. White and Dr Carl J. Wiggers.

An exceptionally interesting chapter of statistical information by Louis J. Dublin of the Metropolitan Life Insurance Company is included.

The editor, Dr Levy, covers the clinical aspects of the subject and also syphilis of the coronary arteries as well as treatment. Dr William J. Kerr was assigned the subject of involvement of the coronary system by embolism, periarteritis nodosa, aneurism and rheumatism. Dr Paul D. White's discussion of the clinical significance of cardiac pain is a particularly practical discussion colored by his broad experience. Electrocardiographic diagnosis is discussed by Dr Frank A. Wilson and is well illustrated by many typical electrocardiograms.

Surgical treatment of pain and paravertebral injection of alcohol are discussed by Dr James C. White. Dr Herman A. Blumgart presents his brief for the relief of cardiac pain and congestive heart failure by total thyroidectomy, a method not as universally acceptable as he indicates. Dr Claude S. Beck very briefly discusses his work in the development of a new blood supply by operation.

The editor is to be commended on the selection of his co-authors. The inclusion of a roentgenologist might have been considered advisable and perhaps a chemical consideration of the problem. The frequent relationship of other diseases is mentioned by many of the authors and somewhat briefly dismissed. The book deserves an excellent recommendation for presenting the modern concepts of the subject.

C. C. MAYER.

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DR BETTERMAN'S DIARY FOR THE YEARS 1908-1913. 1893, 1909, 1910. Collated from the Old Doctor's journals and edited by Charles Elton Blanchard, M.D., Youngstown, Ohio. Medical Success Press, 1931.

MARRIAGE AND PERIODIC ABSTINENCE: THE NATURAL METHOD OF SCIENTIFIC FAMILY REGULATION. By J. C. H. Holt, M.D., London, New York and Toronto. Longmans, Green and Co., 1937.

THE LITTLE THINGS IN LIFE: THE VITAMINS, HORMONES AND OTHER MINUTE ESSENTIALS FOR HEALTH. By Barnett Sure, Ph.D., New York and London. D. Appleton Century Co., 1937.

VEIT'S HANDBUCH DER GYNEKOLOGIE. Edited by W. Stöckel. Vol. 11.—DIE BEZIEHUNGEN DES NERVENSYSTEMS ZU DEN NORMALEN BLUTLEITUNGS- UND ZU DEN FUNKTIONELLEN STÖRUNGEN IM WEIBLICHEN GENITAL. By Dr. Max Walthard, Munich. J. F. Bergmann, 1931.

SEXUAL LOWER. By Chester Tilton Stone, M.D., New York and London. D. Appleton Century Co., 1937.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY. Vol. 61 for the year 1936. Edited by Otto H. Schwarz, M.D., St. Louis. The C. V. Mosby Co., 1937.

OXFORD MEDICAL PUBLICATIONS. HIGH BLOOD PRESSURE. By I. Harris, M.D., London. Oxford University Press, 1937.

OXFORD MEDICAL PUBLICATIONS. PHYSIOLOGY AND PATHOLOGY OF THE HEART AND BLOOD VESSELS. By John Hesch, M.D. (Budapest), M.D. (Germany). L.R.C.P. London. Oxford University Press, 1937.

CLINICAL CONGRESS OF AMERICAN  
COLLEGE OF SURGEONS

EUGENE H POOL, New York, *President*  
 FREDERIC A BESLEY, Waukegan, *President-Elect*  
 VERNON C DAVIS, Chairman MICHAEL L MASOV, Secretary, *Committee on Arrangements*

## PLANS FOR THE 1937 CLINICAL CONGRESS IN CHICAGO

UNDER the leadership of a strong and representative committee, the surgeons of Chicago are planning to provide a program of surgical clinics and demonstrations and afternoon during the Congress, and similarly clinics and demonstrations in many special subjects. A preliminary schedule of operative clinics and

The Executive Committee in charge of arranging the four following days. All departments of surgery will be represented thereon.

VERNOV C DAVID,

CHAPMAN

Secretary

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KALPI B. BETTMAN

FREDERICK CHRISTOPHER

WARREN H COLE

EDWARD L. COOPER  
JOHN S. COOPER

JOHN A. COLEMAN  
WILLIAM R. CURRY

HARRY CULVER

[illegible]

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RECEIVED

LOAL DAVIS  
GEORGE D'ARONSKI  
LESTER R DRACSTEED  
HARRY S GRADLE  
MI J HUBERT  
SELIM W MCARTHUR  
KARL A MEYER  
A H MONTGOMERY  
OSCAR E NADDAU  
DANIEL B PHEMISTER  
SAMUEL SALINGER  
C F SAWYER

The Committee is assured of the hearty co-operation of the clinicians at the five medical schools and more than fifty hospitals that will participate in the clinical program.

In addition to providing an ample and well ar-

The executive committee for the board of regents is preparing programs for the scientific sessions to be held each evening in the ballroom of the Stevens Hotel. At the opening session on Monday evening the retiring president, Dr. Eugene H. Pool, of New York, will deliver the presidential address and the new officers—Dr. Frederick A. Besley, of Wakeham, president, Dr. Frank W. Lynch, of San Francisco, and Dr. Austin B. Schumbein, of Vancouver, vice-presidents—will be inaugurated. The 1937 class of initiates will be received into Fellowship at this session. On Tuesday, Wednesday and Thursday evenings eminent surgeons of the United States and Canada, together with a number of visiting surgeons from foreign countries, will present and discuss papers dealing with surgical subjects of timely import-

[illegible]

sound and silent pictures to be exhibited daily at headquarters

The annual hospital conference will open the Congress with a session in the ballroom of the Stevens Hotel at 10 o'clock on Monday morning. An interesting program of papers, round table conferences and practical demonstrations dealing with problems related to hospital efficiency is being prepared for sessions on Monday, Tuesday, Wednesday and Thursday. It is proposed to make this year's session of wide interest and practical character through a careful selection of subjects to be presented and discussed by surgeons and hospital executives. Particular emphasis will be directed toward professional standards and the vital problems related to hospital economies.

Headquarters for the Congress will be established at the Stevens Hotel where the grand ball room with its large foyers and other meeting rooms on the second and third floors have been reserved for scientific sessions and conferences.

The Technical Exhibition will be located in the Exhibition Hall in which will be placed the registration and clinic ticket bureaus and the bulletin boards on which the daily clinical program will be posted each afternoon for the following day. Leading manufacturers of surgical instruments & ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented.

The hospitals and medical schools of Chicago afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected, therefore, that those surgeons who wish to attend the Congress will register in advance.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

Admittance to clinics and demonstrations will be controlled by means of special clinic tickets, such plan providing an efficient means for the distribution of the visiting surgeons among the several clinics and insuring against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic is given.





- Blood supply, Coronary sclerosis and angina pectoris treatment by grafting new upon myocardium 270
- Blood vessels Arterectomy with follow up studies on 78 operations 149, retinal Ophthalmological findings in cardiovascular renal disease, 546 Artificially induced thrombophlebitis with suggested new approach to problem of postoperative pulmonary embolism 1002
- Differentiation between peripheral arterial and arteriolar spasticity as aid in selection of cases for sympathetic ganglionectomy 1015
- Bones Osteomyelitis of of hand 1 Small repair 9 lesions of Treatment of old traumatic of face 376 Carbohydrate metabolism disturbance in osteoporosis and Paget's disease associated soft tissue disturbances and results of various therapeutic procedures 747 Importance of early and accurate diagnosis in osteogenic sarcoma ed 1002
- Boots in fractures Economic advantages of early protected weight bearing in fractures of leg foot and ankle 1085
- Bowel Rupture of Treatment of abdominal trauma 373
- Bowen's disease Early recognition and treatment of cervical cancer 977
- Brain Interlocking osteoplastic cranial flap method to prevent lateral movement 949
- Breast Mammography roentgenographic diagnosis of tumors by means of contrast media 593 Cancer of prognosis in surgically treated cases 609

**C**ALCIUM deposits Carbohydrate metabolism disturbance in osteoporosis and Paget's disease associated soft tissue disturbances and results of various therapeutic procedures 747

Calculus renal Initiating lesions of 201

Cameron Irving Heward 968

Cancer Report on second International Congress of Scientific and Social Campaign against 468 clinic in a general hospital with public and private patients 490 clinic in a university hospital 502 campaign Early recognition and treatment of cervical 977

Cancer clinic State aided 508 in a private hospital 510

Cancer institute Factors relating to organization and conduct of special 504

Canthus Occupational study of cancer of eye and adnexa 458

Carcinoma survival rates Treatment of cancer of cervix uteri at Rhode Island Hospital report of 203 cases with 5 year follow up 30 Chronic intestinal obstruction due to lesions of large bowel 281 Resection of rectosigmoid and upper rectum for cancer with end-to-end union 313

Carpals Small bone repair 9

Catgut Clinical study of in relation to abdominal wound disruption with test of its tensile strength on patients 648 Postoperative wound complications clinical study with special reference to use of silk 761 Fallacies concerning chemically sterilized surgical catgut sutures with particular reference to use of metallic silver 1027

Cesarean section More conservatism in 318 8 year survey of at William H Coleman Hospital 1015

Cheek Early local care of face injuries 358 Neglected and recurrent basal cell epitheliomas of face 675

Chemical changes Certain in experimental high intestinal obstruction 892

Child bearing Frequency of conceptions in families having congenitally malformed children study of 208 consecutive families 646

Childbirth Study of placenta accreta 178 Pelvic variations in 300 primiparous white women clinical study and proposed classification 700

Children fractures in, Common fractures about elbow joint in 447 Primary bladder tumors in infants and young with report of case of hemangioma in male child 27 months of age 914

Children's diseases Hydronephrosis in infancy and childhood clinical data and report of 101 cases 634

Chondroma, Tumors of hand 129

Chorioepithelioma Hydatidiform mole and 5 year study, 1021

Choroid Clinical considerations of melanotic neoplasms of eye and orbit 513

Ciliary body Clinical considerations of melanotic neoplasms of eye and orbit 513

Clavicle Old ununited fractures of the clavicle in adult 1064

Clostridium welchii and associated organisms, review and report of 43 new cases 1005

Clinical clerkship Undergraduate teaching of surgery ed 711

Coleman William H, Hospital an 8 year survey of cesarean sections at 1035

Colon, Closure of colostomy 59 Chronic intestinal obstruction due to lesions of large bowel 281 How surgery of colon and rectum developed 103 Carcinoma of study of 38 cases 718 Observations on human being following colectomy or colonic exclusion with ileostomy 849

Colostomy Closure of 59

Compensation insurance Insurance company relationships and responsibilities in 393

Conceptions 1 frequency of in families having congenitally malformed children study of 208 consecutive families 646

Conjunctiva Clinical considerations of melanotic neoplasms of eye and orbit 513

Coronary artery Coronary sclerosis and angina pectoris treatment by grafting new blood supply upon myocardium 270

Costoclavicular space Old ununited clavicular fractures in adult 1064

Cranium Interlocking osteoplastic cranial flap method to prevent lateral movement 949

Cyclopropane Clinical use of, 156

Cystography Diagnosis and treatment of tumors of bladder by means of roentgen rays, 989

**D**EHYDRATION Rationalizing treatment in acute intestinal obstructions 273, Clinical and laboratory findings after excessive loss of intestinal fluid from ileum 617

Diabetes surgical Mortality in criteria and technique in extremely lesions 5 year study of 496 cases 926

Diagnosis, Art and science of surgery 513

Disease cardiovascular renal Ophthalmological findings in 546 Paget's Carbohydrate metabolism disturbance in osteoporosis and associated soft tissue disturbances and results of various therapeutic procedures 747 Pott's Spinal fixation ultimate results in 4 cases with verified at secondary operation 826

Bowen's Early recognition and treatment of cervical cancer 977 Buerger's Raynaud's Differentiation between peripheral arterial and arteriolar spasticity as an aid in selection of cases for sympathetic ganglionectomy 1015

Dugas Louis A 714

Duodenum Irresistence of duodenal ulcers after suture of an acute perforation 172 Treatment of perforated duodenal ulcers 235 Acute perforation of peptic ulcer evaluation of contributory and exciting causes 863



- 504 Ophthalmological findings in cardiovascular renal disease, 546
- Hemorrhage, treatment of Severe and fatal reactions following intravenous use of gum acacia glucose infusions, 772
- Hernia in industry, 400 Edoardo Bassini, his role in development of hernial surgery, 971
- Heterotropia, Surgical results in 23 cases of especial reference to orthoptic training, 338
- Hibbs, Russell A. 1060
- Hip joint, Fracture of treatment of extra articular fixation with adjustable nails, 420
- Hoarseness, Laryngectomy for treatment of cancer of larynx, 524
- Hodgkin's disease, Classification and prognosis of and allied disorders, 463
- Hollywood Hospital Cancer clinic in the private hospital, 510
- Hospital private, Cancer clinic in 510
- Hopital standardization ed. 562
- Humerus, Essential features in fractures of the shoulder 347 Fractures of the functional method of treatment, 919
- Hypodidiform mole and chorionepithelioma, 5 year study 1021
- Hydronephrosis, in infancy and childhood, clinical data and report of 101 cases, 634
- Hypertension arterial Ophthalmological findings in cardiovascular renal disease, 546
- Hyperthyroidism Management of severe, 504 Hemithyroidectomy in stages in treatment of 1033
- I**LEUM Clinical and laboratory findings after extensive loss of intestinal fluid from 61
- Ileus, Chronic intestinal obstruction due to lesions of the large bowel 51 Mortality rate of appendicitis, ed. 836
- Incision McBurrey Survey of appendicitis in San Diego 39
- Incontinence urinary Spina lunda, report of cystometric studies in series of 5 cases with some suggestions regarding their clinical management 1
- Industrial medicine, Chytridium welchii and associated organisms, review and report of 42 new cases, 100
- Infants, Primary bladder tumors in and young children with report of case of hemangioma in male child 27 months of age 614
- Infants' diseases, Hydronephrosis in infancy and childhood clinical data and report of 101 cases 634
- Infections, surgical Prophylactic and active treatment of surgical infections with zinc peroxide 55
- Influenza, Occupational study of cancer of eye and adnexa, 450
- Injuries, General management of 9
- Instruments and apparatus Van Gorder fracture frame, Fractures of shaft of femur critical end result study of 103 consecutive cases at Massachusetts General Hospital, 210 Pentoscope Differential diagnosis of ectopic gestation by pentoscopy 9 Wagners siphon Rationalizing treatment in acute intestinal obstructions, Smith Petersen 3 Fargel nail Treatment of fractures of neck of femur by internal fixation 57 Stoeck fracture of pine bed, Management of fracture dislocations of vertebrae associated with spinal cord injuries, 407 adjustable nails, Fracture of hip joint, treatment by extra articular fixation with, 40 Johnson Goldthwaite hyperextension frame Taylor back brace, Fractures of distal and lumbar vertebrae 440 Zeiss binocular corneal microscope, Surgery and medicine in treatment of glaucoma, 552
- Kymograph Resistance of phincter of Oddi in human, 622 Boehler pins, Fractures of os calcis, 66 Gemma color clamp Carcinoma of colon, study of 38 cases, 738 Hunman probe and cautery Lretero-intestinal implantation by aseptic method with divisible carrier modification of simple 7 suture method with probe and cautery 853 Cutter forceps thoracotomy, Principles of percutaneous, 80 beaded wire fixation of fractures, Kirschner wires, Use of beaded wires for internal fixation in certain oblique and spiral fractures of extremities, 531 Anderson anatomic pin, Fractures of humerus, functional method of treatment, 919 Kirschner wires, Smith Petersen nail, Fractures of neck of femur fixation by means of 103 444 wire Fractures of patella, 103 boots, Economic advantages of early protected weight bearing in fractures of leg foot, and ankle 1005
- Insulin therapy Glucose to cranee as diagnostic aid in jaundice. II Further differentiation of cases showing obstructive type of curve, 993
- Insurance company relationships and responsibilities in compensation insurance 91
- Interlocking osteoplastic cranial flap method to prevent lateral movement, 940
- International Congress of Scientific and Social Campaign against Cancer Report on second 400
- International medicine Internationalism in medicine, ed. 904
- Intestines, Unplanned approach for suture of acute perforation of peptic ulcer 8, Cure of pancreatic fistula by pancreato-jejunostomy report of case with review of literature 70 Rationalizing treatment in acute intestinal obstructions, 53 lesions of obstruction Chronic intestinal due to lesions of large bowel, 51 Reaction of recto-sigmoid and upper rectum for cancer with end-to-end union 313 Clinical and laboratory findings after extensive loss of intestinal fluid from the ileum 61, How surgery of colon and rectum developed 53, Carcinoma of colon, survey of 33 cases, 734 Lretero-intestinal implantation by aseptic method with divisible carrier modification of simple 7 suture method with probe and cautery
- Intussusception during pregnancy 811 Observations on human being following colectomy or colonic exclusion with ileo-jejunostomy 243 Acute perforation of peptic ulcer evaluation of contributory and exciting causes 563 Lymphatics in omental adhesions, 80 obstruction Certain chemical factors in experimental ileus 537 Pitressin (beta hypophysectomy) in laparotomies, 53
- Intussusception during pregnancy 811
- Iodine Factors of use of after operation following bilateral subtotal thyroidectomy preliminary report, 99
- Iodine therapy Hemithyroidectomy in stages in treatment of hyperthyroidism 103
- Iris, Clinical considerations of melanotic neoplasms of eye and orbit, 513
- J**ANUICE hemolytic, Combined spera clasp, removal with medical and surgical therapy in spermatitis, 56 Glucose to cranee as diagnostic aid in II Further differentiation of cases showing obstructive type of curve 993
- Jaws, Fractures of and treatment, 60 Early local care of face injuries, 3 Traumatic deformities of nose and other bones of face 3
- Jejunum Cure of pancreatic fistula by pancreato-jejunostomy report of case with review of literature Treatment of perforated duodenal ulcer 5 Lymphatics in omental adhesions, 82

KIDNEY, Ectopic ureteral orifice, report of 17 cases in children, 22. Cardiac asthma and acute pulmonary edema, complications of non convulsive toxemia of pregnancy, 39. Initiating lesions of renal calculus, 201. Changing mortality of urologic surgery, ed 247. Ophthalmological findings in cardiovascular renal disease, 69.

hood, clinical data and report of 101 cases, 634  
Ectopic kidney review of 97 cases 935. Sarcoma of  
renal hilus, 944. Renal tuberculosis with special refer  
ence to follow up results in Squier Clinic 1046  
Knee. Cruciate ligament injuries caused by complete and  
incomplete dislocations, early and late pathology of  
symptoms, and method of repair, 218. Treatment of  
giant cell tumors about study of 157 cases collected  
by Registry of Bone Sarcoma of American College of  
Surgeons 483. Metastasis in analysis of knee by  
interposition of patellar straps 673  
Two joint. Complete dislocations of report of 7 cases  
with end results, 94  
study of 38 cases, 738  
Treated cases, 609, diagnosis in, Carcinoma of colon,  
mortality. Cancer of breast, prognosis in surgically  
hospital, 510. Laryngectomy for cancer of larynx 524  
State aided cancer clinic, 508. Cancer clinic in private  
university hospital 502. Factors relating to organiza  
tion and conduct of special cancer institute, 504  
public and private patients 499. Cancer clinic in  
patients, 497. Cancer clinic in general hospital with  
Extension of tumor clinic service to include private  
Scientific and Social Campaign against Cancer, 466,  
Italy, Report on second International Congress of  
face 532

**LABOR.** Pelvic variations in 300 primiparous white women; clinical study and proposed classification 700  
Placemoment of ligaments in pregnancy and lower uterine segment, 906, Lycopodium kidney, review of 97 cases, 933, 8 year survey of cesarean sections at William H. Coleman Hospital 1035

Landmarks in surgery, William Beaumont and account of Alexis St. Martin, 121 Edoardo Bassini, his role in development of hernial surgery, 971

Laparotomy, Pittsness (beta hyphomennia) in 895  
Laryngoscopy, Laryngectomy for treatment of cancer of larynx, 524  
Larynx, Cancer of larynx, Laryngectomy for cancer of, 524

**M.**

Malignant tumors, Radical operation for, of thyroid gland, 56  
Malignancy, removal of carcinoma of upper extremity, 56

Mammography, roentgenographic diagnosis of breast tumors by means of contrast media, 593  
Mandible, Fracture of jaw and treatment, 69

Martin Franklin H., SURGERY, Gynecology and Obstetrics—An international journal, ed. 113, Imbrie, Medical practice and law, some parallels, relation ships, and problems, 576

Massachusetts General Hospital Fractures of shaft of femur, critical and result study of 109 consecutive cases 508

Massachusetts cancer program, State aided cancer clinics, 508

law, medical practice and some parameters, relationships, and problems, 376  
 Leg, Economic advantages of early protected weight bearing in fractures of, foot, and ankle 1085  
 Leucoplasia, Early recognition and treatment of cervical cancer, 977  
 Ligaments, cruciate, injuries, caused by complete and incomplete dislocations, early and late pathology, 218  
 Ligatures, Fallacies concerning chemically sterilized surgical catgut sutures, with particular reference to use of metallic suture, 1027  
 Lightheartedness, Phenomenon of, in pregnancy and lower uterine segment 906  
 Lin, Norfield and recent basal cell epitheliomas of 102

Lungs. Cardiac asthma and acute pulmonary edema common  
studies on 78 operations 140  
Lumbago sympathetomy 146  
glands and floor of mouth, 517  
Ludwig's angina. Pathological conditions affecting salivary  
technique of, and pneumonectomy 209  
Lobectomy. Surgical treatment of carcinoma of lung,  
non of cases showing obstructive type of cure 99  
as diagnostic aid in jaundice II Further differentiation  
of gall bladder diseases 171, Glucose tolerance  
test 171  
Liver. Seric acid fatil reactions following intravenous use  
Lipoma. Tumors of hand 120  
face, 675  
Liquor. Preparation and treatment before eye operations on  
Anterior chamber drainage of conjunctiva, 403, Indications for  
Occupational study of cancer of eye and adnexa, 458  
ancient Education of surgeon past and present, 570,  
Art and science of surgery, 583, Internationalism in,  
Nemor, Robert Bailey Greenough, 838  
Memorial Hospital, New York City, Factors relating to  
organization and conduct of special cancer institute,  
Menses cycle, Physiology of human cervical mucosa, 758  
Menstruation. Endocrine therapy in gynecology, ed 833  
Metabolism, carbohydrate, disturbance in osteoporosis  
Observations on humans being following collection of  
and results of various therapeutic procedures, 747,  
Operations on humans being following collection of

30. Surgical treatment of carcinoma of technique of lymphadenectomy, 209, Principles of pneumonectomy, 820 Artificially induced thrombophlebitis, with suggested new approach to problem of postoperative pulmonary embolism, 1002 Lymph nodes, Classification and prognosis of Hodgkin's disease and allied disorders, 46

103. Craniocleid Metatarsals, Alfred S. Taylor for Method, Russell traction, Fractures of femur treated by, 103, Craniocleid Metatarsals, Alfred S. Taylor for

cervical dislocation Management of fracture dislocations of vertebrae associated with spinal cord injuries 407 Fracture of hip joint treatment by extra articular fixation with adjustable nails 420 Young's radical cure of cancer of prostate 472 Boehler, Fractures of os calcis 663, Agnew's Modified operation for syn dactylism 793, Hibbs Albee Spinal fixation ultimate results in 4 cases with Pott's disease verified at sec ondary operation 826

Microscope Surgeon's interest in new world ed 966

Montreal General Hospital Cancer clinic in general hos pital with public and private patients 499

Mortality Survey of appendicitis in San Diego 239

Shock ed 245 Changing of urologic surgery, ed 247 in surgical diabetes—criteria and technique in ex tremity lesions 53 year study of 496 cases 956

Mortality statistics Mortality rate of appendicitis ed 836

Moulinier Father C B tribute Medical practice and law some parallels relationships and problems 516

Mouth Pathological conditions affecting salivary glands and floor of 517

Mucosa gastric Prolapse of through pylorus surgical treatment 689 cervical The physiology of the hu man 758

Muscle quadriceps Complete dislocations of knee joint report of 7 cases with end results 94

Myocardium Coronary sclerosis and angina pectoris treatment by grafting new blood supply upon myo cardium 210

**N**ASAL bones Fractures of jaws and treatment 69

Treatment of old traumatic bony lesions of face 376

Neoplasms melanotic (clinical considerations of eye and orbit 513

Nerves peripheral Tumors of hand 129 cardiac Mecha nism of relief of pain immediately after total thyroidec tomy for angina pectoris and congestive failure 105 auditory Irenatal medication and its relation to fetal ear 542 peripheral Differentiation between periph eral arterial and arteriolar spasticity as aid in selec tion of cases for sympathetic ganglionectomy 1015

Neuritis Scalenus syndrome ed 119

Nose saddle Multiple stage operation for difficult avoid ance of scar 102 Early local care of face injuries 358 Traumatic deformities of and other bones of face 532 Neglected and recurrent basal cell epitheliomas of face 673

**O**BSTETRICS Study of placenta accreta 118 More conservatism in cesarean section 338 Pelvic varia tions in 300 primiparous white women clinical study and proposed classification 100 Visscher Bowman chemical test for pregnancy and urinary pigment 806 Intussusception during pregnancy 811 Phenom enon of lightening in pregnancy and lower uterine segment 906

Occupational diseases of eye Occupational study of cancer of eye and adnexa 458

Olecranon Common fractures about elbow joint in chil dren 447 Fractures of patella 1074

Omentum Lymphatics in omental adhesions 872

Operations Wertheim's hysterectomy Radium versus in treatment of carcinoma of cervix 332 Stabilizing of foot Arthrodesis of foot in infantile paralysis 194

Orbit Clinical considerations of melanotic neoplasms of eye and 513

Orthopedic surgery Some observations on in Europe ed 1094

Orthotic training Surgical results in 223 ca es of hetero tropia, especial reference to 338

Os calcis Fractures of bones of foot—except 454 Fractures of 663

Os trigonum Fractures of bones of foot—except os calcis, 454

Osteomyelitis of bones of hand 1

Osteoporosis Carbohydrate metabolism disturbance in, and Paget's disease associated soft tissue disturbances and results of various therapeutic procedures, 747

Out patient department Undergraduate teaching of sur gery ed 711

Ovary Physiology of human cervical mucosa 758 Endo crine therapy in gynecology ed 833 Hydatidiform mole and chorioepithelioma, 5 year study 1021

**P**AIN Mechanism of relief of, immediately after total thyroidectomy for angina pectoris and congestive failure 165

Pancreas Cure of pancreatic fistula by pancreatojejunostomy report of case with review of literature 19

Paralysis infantile Arthrodesis of foot in 194

Paré Ambrose op 1

Parotid gland Pathological conditions affecting salivary glands and floor of mouth 517

Pasteur Surgeon's interest in new world ed 966

Patella Complete dislocations of knee joint report of 7 cases with end results 94 Arthroplasty in ankylosis of knee by interposition of patellar flaps 673 Frac tures of 104

Patients private Extension of tumor clinic service to in clude 497 ward and private Cancer clinic in general hospital with 499

Pelvis Pelvic variations in 300 primiparous white women clinical study and proposed classification 100 con tracted 83 year survey of cesarean sections at William H Coleman Hospital 1035

Pentothal sodium for intravenous anesthesia 858

Peptic ulcer Acute perforation of evaluation of contribu tory and exciting causes, 863

Perforation Acute of peptic ulcer evaluation of con tributory and exciting causes 863

Peritoneoscopy Differential diagnosis of ectopic gestation by 279

Peritonitis Chronic intestinal obstruction due to lesions of large bowel 281

Phalanges Osteomyelitis of bones of hand 1, Small bone repair 9

Physick Philip Syng 718

Physiology of human cervical muco-a 38 Observations on human being following colectomy or colonic exclu sion with ileostomy 849 Certain chemical factors in experimental high intestinal obstruction 892

Pigment urinary Visscher Bowman chemical test for pregnancy and urinary pigment, 806

Pitressin (beta hypophamine) in laparotomies 893

Pituitary gland extract Pitressin (beta hypophamine) in laparotomies 893

Placenta accreta Study of 178

Placenta previa 8 year survey of cesarean sections at William H Coleman Hospital 1035

Plastic surgery Traumatic deformities of nose and other bones of face 532

Pneumocystography Diagnosis and treatment of tumors of bladder by means of roentgen-rays 989

Pneumocyst Principles of 820

Pneumonectomy Surgical treatment of carcinoma of lung technique of lobectomy and 99

Porcelain Injuries of hands due to shattered handles of water faucets 920

Pregnancy Cardiac asthma and acute pulmonary edema complications of non-convulsive toxemia of 39



Surgeon, Education of past and present, 5,0, interest in new world, ed 966

Surgery anesthesia, Evipal anesthesia and combination of intravenous with general and local anesthesia 89, technique Clinical use of cyclopropane 156 Changing mortality of urologic ed 247 traumatic Industrial medicine and 3,2 Art and science of 533 technique Clinical study of catgut in relation to abdominal wound disruption with test of its tensile strength on patients, 648 of intestines, evolution of How surgery of colon and rectum developed 705 Undergraduate teaching of ed 711 Postoperative complications wound clinical study with special reference to use of silk 163 technique Interlocking osteoplastic cranial flap method to prevent lateral movement 949 postoperative complications, Artificially induced thrombophlebitis, with suggested new approach to problem of postoperative pulmonary embolism 1002 technique Fallacies concerning chemically sterilized surgical catgut sutures with particular reference to use of metallic silver 102,

**SURGERY GYNECOLOGY AND OBSTETRICS** an international journal ed 118

Surgical clinics Undergraduate teaching of surgery ed 711 Sutures, Postoperative wound complications clinical study with special reference to use of silk 163 fallacies concerning chemically sterilized surgical catgut with particular reference to use of metallic silver 102 Syndactylism Modified Agnew's operation for 793 System sympathorenal Shock ed 245

**TARSALS** Small bone repair 9

Teaching Undergraduate of surgery ed 11

Teeth Pathological conditions affecting salivary glands and floor of mouth 517

Telangiectatic granuloma Tumors of hand 19

Test Visser Bowman for pregnancy and urinary pigment 806 histamineskin vasodilating Differentiation between peripheral arterial and arterenar spasticity as aid in selection of cases for sympathetic ganglionectomy 1015 Aschheim Zondek Hydatidiform mole and chorioepithelioma 5 year study 1021

Thomas Hugh Owen Osteomyelitis of bones of hand 1

Thrombo angust obliterans Arterectomy with follow up studies on 78 operations, 149

Thrombophlebitis, Artificially induced with suggested new approach to problem of postoperative pulmonary embolism 1002

Thorax Surgical treatment of carcinoma of lung technique of lobectomy and pneumonectomy 99

Thyroid crisis, Management of severe hyperthyroidism 394

Thyroid gland Mechanism of relief of pain immediately after total thyroidectomy for angina pectoris and congestive failure 165 Management of severe hyperthyroidism 304 Diffuse colloid goiter 604 Radical operation for malignant tumors of 927 Fallacy of use of iodine after operation following bilateral subtotal thyroidectomy preliminary report 999 Hemithyroidectomy in stages in treatment of hyperthyroidism 1035

Tibia, Complete dislocations of knee joint, report of 7 cases with end results 94 Treatment of giant cell tumors about knee study of 153 cases collected by Registry of Bone Sarcoma of American College of Surgeons 485

Transportation of injured Treatment of abdominal trauma 373 Fractures of dorsal and lumbar vertebrae 440 Transurethral resection its indications limitations, and complications 324

Trauma General management of injuries, 397

Traumatic surgery Clostridium welchii and associated organisms, review and report of 43 new cases, 100, Tuberculosis, Principles of pneumolysis, 80 Real and special reference to follow up results in Squier Clinic 1040

Tumors of hand 19 giant cell Treatment of also 111 Knee study of 153 cases collected by the Registry of Bone Sarcoma of the American College of Surgeons 485

Tumor clinic Cancer clinic in general hospital with public and private patients, 499, Cancer clinic in cancer hospital 502 State aided cancer clinic 500 Cancer clinic in private hospital 510

Tumor clinic service Extension of to include private patients, 497

Tumor institute Factors relating to organization and conduct of special cancer institute 504

**ULCER** gastric Transformation of into gastric carcinoma 16 peptic Partial gastrectomy in acute perforated observation on diagnosis and treatment of 46 new cases 63 peptic, Simplified approach for suture of acute perforation of 6 duodenal, Persistence of after suture of acute perforation, 1 treatment of perforated duodenal 35

University hospital Cancer clinic in 502

Ureter Ectopic ureteral orifice, report of 1, cases in children 22 Physiological changes in ureter associated with pregnancy relationship between atony and dilatation of tract 51 hydronephrosis in infancy and childhood clinical data and report of 101 cases, 644 Uretero intestinal implantation by aseptic method with dissolvable carrier modification of simple suture method with probe and cautery 183

Urethra, Transurethral resection its indications, limitations and complications 324

Urinary tract Physiological changes in ureter associated with pregnancy relationship between atony and dilatation of tract 51 Changing mortality of urinary surgery ed 247 Litres in (beta hypophosphatase) in laparotomies, 895

Urine Visser Bowman chemical test for pregnancy and urinary pigment 806

Urology Changing mortality of urologic surgery ed 47

Uterus, Phenomenon of lightening in pregnancy and lower uterine segment 906

Uterus cervix Treatment of cancer of at Rhode Island Hospital report 93 cases with 5 year follow-up 30 Radium versus Wertheim's hysterectomy in treatment of carcinoma of 337 Physiology of human cervical mucosa 758 Early recognition and treatment of cervical cancer 9,7

**VAGINA** Omental flap in transperitoneal repair of recurring vesicovaginal fistulas, 74

Vascular system Pitressin (beta hypophosphatase) in apertotomies, 895

Vertebrae Management of fracture dislocations of associated with spinal cord injuries, 40 Fractures of dorsal and lumbar 440 Spina biunda urinary continence report of cystometric studies in series of 30 cases with some suggestions regarding their management, 721 Spinal fixation ultimate results in 4 cases with Pott's disease venued at secondary operation 80

Vesalius, Andreas, op 721

Vesicovaginal fistula Omental flap in transperitoneal repair of recurring 74

Virus Surgeon's interest in new world ed 966



- of medical services in industry by American College of Surgeons, 403
- Wound, Clinical study of cautery in relation to abdominal wound disruption, with test of its tensile strength on patients 648, Postoperative, complications, clinical study with special reference to use of silk, 765
- Wrist, Small bone repair, 9, Deformity of, following resection of radial head, 1079
- XANTHOVA, Tumors of hand, 129
- ZINC peroxide, Erythylactic and active treatment of surgical infections with, 327
- AR, Internationalism in medicine, ed 964
- Ward walls, Undergraduate teaching of surgery, ed 711
- light beams; Economic advantages of early protected in fractures of leg foot, and ankle 1085
- chester Medical College 841
- study of 153 cases collected by Registry of Bone Sarcoma of American College of Surgeons, 485
- traumatic surgery 372, Insurance company relations and responsibilities in compensation insurance, 393, Hernia in industry 400, Report on 1930 surveys

# BOOK REVIEWS

- BAILEY, HAMILTON. Diseases of the Testicle, 1101
- BERENS, CONRAD. The Eye and Its Diseases. By 62 International Authorities. Edited by Conrad Berens. 255
- BERTWISTLE, A. I. A Descriptive Atlas of Radiographs and Aid to Modern Clinical Methods. 847
- BROWNE, O. DOVELL. A Manual of Practical Obstetrics. 1103
- CABOT, HUGH. Modern Urology. In Original Contributions by American Authors. Edited by Hugh Cabot. Vol. 1—General Considerations. Diseases of Penis and Urethra. Diseases of Scrotum and Testicle. Diseases of Prostate and Seminal Vesicles. Vol. 2—Diseases of the Bladder. Diseases of the Ureter. Diseases of the Kidney. Radiation Therapy of Tumors of the Genito-urinary Tract. 3d rev. ed. 1101
- CASTLE, WILLIAM BOSWORTH and MINOT, GEORGE RICHARD. Oxford Medical Publications. Pathological Physiology and Clinical Description of the Anemias. Edited by Henry A. Christian. (Reprinted from Oxford Loose Leaf Medicine.) 255
- CHRISTOPHER, FREDERICK. A Textbook of Surgery. By American authors. Edited by Frederick Christopher. 126
- CORIN, G. Etude de l'influence des glandes endocrines sur le squelette. Archives Intern. de Médecine Expérimentale. Vol. 11. Fasc. 1-2. 127
- CROSSEN, HARRY STURGEON and CHAMBERLAIN, ROBERT JAMES. Gynecology for Nurses. 2d ed. 254
- EDWARDS, HAROLD CLIFFORD. Surgical Emergencies in Children. 126
- ELLIOTT, SIR JAMES. Scalpel and Sword. 974
- GOSSET, A. et al. Techniques chirurgicales. 26
- HERMANN, LOUIS C. Vascular Exercises and the Conservative Management of Obstructive Arterial Diseases of the Extremities. With a foreword by Mont R. Reid. 127
- HINTON, WILLIAM A. Syphilis and its Treatment. 845
- HOLMES, GEORGE W. and RUGGLES, HOWARD I. Roentgen Interpretation: a Manual for Students and Practitioners. 5th rev. ed. 1101
- INGLIS, ELIOT. Oxford Medical Publications. Paget's Disease of the Nipple and its Relation to Surface Cancers and Precancerous States in General. 1102
- JACKSON, CHEVALIER and JACKSON, CHEVALIER. Diseases of the Air and Food Passages of Foreign Body Origin. 975
- LAMBERT, O. MALATRAY H. and DRISSSENS, J. La chirurgie du cancer du pœmon: bases anatomocliniques et expérimentales technique opératoire. 975
- LEVY, ROBERT I. Diseases of the Coronary Arteries and Cardiac Pain. Edited by Robert I. Levy. 1103
- LOWSELY, OSWALD SWINNEY and KIRWIN, THOMAS JOSEPH. Urology for Nurses. 1102
- LUTEN, DREW. The Clinical Use of Digitalis. 1102
- MACALPINE, JAMES B. Cystoscopy and Urography. rev. ed. 255
- MAINCOT, RODNEY. Post Graduate Surgery. Edited by Rodney Maingot. With introduction by The Hon. Lord Moynihan of Leeds. Vol. 1. 125
- 845
- MCBRIDE, LARL D. Disability Evaluation, Principles of Treatment of Compensable Injuries. 846
- NICKLIS, W. J. STEWART. Appendicitis: When and How to Operate, a Guide for the General Practitioner. 1103
- MEAKINS, JONATHAN CAMPBELL. The Practice of Medicine. 1103
- PETER, LUTHER C. The Extra Ocular Muscles: a Study of Normal and Abnormal Ocular Motility. The Practitioner's Library of Medicine and Surgery. 10—Dermatology and Syphilology. 126
- PUGH, M. A. Oxford Medical Publications. Squinting. 719
- ROLLESTON, SIR HUMPHRY DAVY. Oxford Medical Publications. The Endocrine Organs in Health and Disease with an Historical Review. 974
- ROISTER, HERBERT ASHLEY. Medical Morals and Medicine. 974
- SCHULBERG, OSCAR O. Acta Chirurgica Scandinavica. Supplement 43—On the Disturbance of the Circulation in Spinal Anæsthesia, an Experimental Study. 720
- SCHULMAN, EDWARD A. A Textbook of Obstetrics. 974
- SILVERMAN, J. EASTMAN. Hoeber's Surgical Monographs. Plastic Surgery of the Nose. 2d ed., entirely revised. 847
- SLOAN, F. P. The Thyroid, Surgery Syndromes. 847
- STANDER, HENRIET J. Williams' Obstetrics: a Text for the Use of Students and Practitioners. (A revision and enlargement of the text originally written by J. Whitridge Williams.) 1101
- THOMPSON, WALKER, SIR JOHN. Surgical Diseases and Injuries of the Genito-Urinary Organs. Edited by Kenneth Walker. 2d ed. rev. 256
- VAUGHAN, JANET M. Oxford Medical Publications. Anæmias. With Notes on Normal and Pathological Erythropoiesis by Hubert M. Turnbull. 1101
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- WOODWARD, HENRY L. and CARDNER, BERNICE. Obstetrics: Management and Nursing. 1103
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